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THE SECOND DECENNARY OF THE AMERICAN NATURALIST.

IN entering upon the second decennial period of the existence of the American Naturalist, we may be pardoned for looking with some pride upon the success that has attended its establishment. If the reader will turn to the introductory words stating our aims in the first number, published in March, 1867, we think he will agree with us that the promises there given have been fulfilled as completely as could reasonably be expected.

Our aim has been to popularize the best results of the study of natural history, and thus serve as a medium between the investigator on the one hand and the teacher and student on the other. Thus, while we have attempted to inform the science-teacher of the latest discoveries in biology and geology in their broadest sense, including the theories of the origin of plants and animals, and the history of the earth and man, we have endeavored to attract and sustain the interest of the young. We know that a number of young naturalists have made their *début* in the scientific world in our magazine, while some of the most important results of the investigations of our leading scientists have first seen the light in its pages.

The progress in biology during the past ten years has been greater than is generally imagined. Text-books become superannuated within a decennary. Teachers and even working naturalists need the presence and stimulus of a monthly journal reaching beyond the limits of their specialties to keep them from nodding at their work. If we have failed to record all the new discoveries, it has been due in great part to lack of space.

We must again return thanks to our contributors, whose zeal and generosity have made the magazine what it is. From the first our articles have been given freely, out of love for the cause of science, and a desire for its free progress.

We have, in moments of discouragement and financial distress, felt sorely the want of proper material support from a people numbering upwards of forty-four millions, and of so much general intelligence and culture as ours; but so rapid has been the diffusion of science among the masses, even since the foundation of this journal, that we feel confident of ample support in the future. That the magazine has not been fully sustained pecuniarily may have been partly its own fault. Our critics tell us that it has not always been sufficiently "popular." We have endeavored to educate a public sentiment in behalf of the study of pure natural science for its own sake, and have sought to instruct rather than to amuse our readers. But the worst times, we trust, have been passed, and we confidently hope, with the new year we are entering upon and the encouraging auspices of the new arrangements begun last year with the present publishers, to excite a more decided enthusiasm among lovers of nature in the thorough success of a journal devoted to their interests.

As it is, the future of our journal is in the hands of persons of scientific culture. It is to the friends of liberal education, — to those who would advance the means of diffusing a knowledge of the methods of right thinking and working in science, which has still to encounter obstacles on all sides, from the ignorant and uncultivated as well as from even the cultivated *littérateur* or poet, trained in all directions except one, that of scientific modes of thought (witness Carlyle's late utterance respecting the theory of evolution), — it is to the friends of the best culture, which embraces scientific as well as classical and technological learning, that we would appeal for aid and support.

The study of science teaches us how to make nature minister to our wants. We learn the lesson from the study of nature that man's progress in intellectual grasp, and increase in moral force, have depended on the gradual improvement of his body. His mental and moral advance is in a ratio corresponding to his ob-

servance of the laws of physiology in its broadest sense. Right conduct is based on obedience to physiological and hygienic laws; and let us not forget that all future progress in the higher education of mankind is primarily dependent on the observance of scientific laws, especially those laid down by the biologist.

The intellectual and moral progress of man, all that is to emancipate him from the gross and materialistic forces of ignorance, bigotry, and prejudice — the outgrowths of the animal propensities he has, with little doubt, inherited from the lower orders of animals — is coördinated with his progress in the knowledge and application of physical laws. If his remote past is associated with reminiscences of the Amphioxus and Ascidians, the one lesson derived from a study of past creations and of existing life is the hope of a glorious intellectual and moral future for his race, and of his increasing capacity for appreciating the Infinite Power which, in a way at present unknown to his philosophy, guides the material and spiritual forces of the universe, and causes them to minister to his highest intellectual and spiritual development.

IS PROTECTIVE MIMICRY DUE TO NATURAL SELECTION?

BY ALFRED W. BENNETT.

IN the American Naturalist for September is an abstract of an article by that able naturalist, Fritz Müller, advocating the view that the curious phenomena of protective mimicry in Lepidoptera can be fully explained by the theory of natural selection. Notwithstanding the deference that is due to the conclusion of so eminent an observer, I have thought that the other side of the question should be heard.

I think it will be generally admitted that when we have a series of similar facts occurring throughout both the animal and vegetable kingdoms, an explanation should be sought that will cover the whole of these facts, while one which explains a portion of them only, but is obviously inapplicable to the remainder, should at least be looked on with suspicion and accepted with hesitation. Now external resemblances of a most minute kind between widely separated species both of animals and plants are

of very frequent occurrence, and, in a very large number of instances, are obviously not "mimetic" nor of any apparent service to the "mimicking" species. As a justification for this assertion, I may refer to a perfectly unexceptionable authority, namely, one of the best known advocates of the theory of natural selection, Mr. A. R. Wallace. In his inaugural address to Section D at the recent meeting of the British Association at Glasgow,[1] Mr. Wallace adduces the following illustrations of this law: "Our first example is from tropical Africa, where we find two unrelated species of butterflies belonging to two very different families (*Nymphalidæ* and *Papilionidæ*) characterized by a prevailing blue-green color not found on any other continent. Again, we have a group of African *Pieridæ*, which are white or pale yellow with a marginal row of bead-like black spots; and in the same country one of the *Lycænidæ* is colored so exactly like these that it was at first described as a species of *Pieris*. None of these four groups are known to be in any way specially protected, so that the resemblance cannot be due to protective mimicry." "In another series of genera, all belonging to the *Nymphalidæ*, we have the most vivid blue ground, with broad bands of orange-crimson on a different tint of blue or purple, exactly reproduced in corresponding yet unrelated species occurring in the same locality; yet, as none of these groups are protected, this can hardly be due to mimicry. A few species of two other genera in the same country also reproduce the same colors, but with only a general resemblance in the marking. Yet again, in tropical America, we have species of *Apatura* which, sometimes in both sexes, sometimes in the female only, exactly imitate the peculiar markings of another genus confined to America. Here again neither genus is protected, *and the similarity must be due to unknown local causes*." Mr. Wallace adduces several other instances of a similar character; and even in the case of the very South American instances on which so much stress is laid by Fritz Müller, and, before him, by Bates, admits that "this can hardly be true mimicry, because all are alike protected by the nauseous secretion which renders them unpalatable to birds."

In the abstract of Fritz Müller's article it is stated that "Fritz Müller insists, as all writers on the subject have done, upon the similar geographical distribution of the imitating and the imitated species as a necessary concomitant of mimicry." If, there-

[1] See Nature, vol. xiv. page 403, September 7, 1876.

fore, it can be shown that species which would be called "imitating and imitated" if they occurred together are in reality found widely separated, it is obvious that this would materially weaken Müller's argument. Whether this is the case with Lepidoptera, I have not sufficient knowledge to state; but that accomplished entomologist, the late Mr. Edward Newman, assured me that in the case of some of the most remarkable instances of such resemblance known in this country, between particular species of Diptera and particular species of Hymenoptera, the resemblance is not associated with geographical contiguity. In the case of plants, at all events, I am prepared to state that resemblances as striking, which would certainly be considered illustrations of mimicry if they were found together and were of any apparent utility, do occur between species widely separated in space.

In the number of the *Popular Science Review* for January, 1872, appeared an article entitled Mimicry in Plants, in which I gave a number of illustrations of plants, or parts of plants, belonging to species widely separated according to any natural system of classification, and yet so exactly alike in their vegetative organs that they would deceive a practiced botanist. The resemblance extends in some instances not merely to general habit and appearance, but even to the arrangement of the veins. Dr. Berthold Seemann, no mean authority, speaks of having met in the Sandwich Islands with a variety of *Solanum Nelsoni*, which looked for all the world like *Thomasia solanacea* of New Holland, a well-known Buttuereaceous plant of our gardens, the resemblance between these two widely separated plants being quite as striking as that pointed out in Bates's Naturalist on the Amazon "between a certain moth and a humming-bird."[1] In no one instance, that I am aware of, in the vegetable kingdom has protective mimicry been suggested as an explanation of this homoplasm. In most cases, as the one recorded above, the plants in question do not grow in contiguity.

But a more serious objection to the theory, that these remarkable resemblances are brought about by natural selection acting in the way indicated by Bates and Müller, lies in the difficulty of understanding how the first steps in the approach of one insect towards another could possibly be useful in deceiving an enemy. All the most cautious advocates of the theory, including Mr. Darwin himself, admit that "natural selection acts with

[1] Gardener's Chronicle, June 27, 1868.

extreme slowness;" and again that "only those variations which are in some way profitable will be preserved or naturally selected." By a train of reasoning founded on these two premises, I attempted to show, in a paper on The Theory of Natural Selection from a Mathematical Point of View [1] read before the British Association at the Liverpool meeting in 1870, that the chances against the required amount of change being brought about by this agency solely, are, on a hypothesis most favorable to the theory, say ten million to one; and I am not aware that the arguments there used have been met. Again, the purpose of mimicry is generally stated to be the perpetuation of the imitating insect, in consequence of deceiving its natural enemies by its resemblance to some species distasteful to them. If so, the purpose seems to have been somewhat inadequately fulfilled, even by the most perfect mimetism, as Mr. Bates and Mr. Wallace agree in stating, that, both in South America and the Malay Archipelago, the imitating species are always confined to a limited area, and are always very scarce compared with the imitated species.

Mr. Wallace, in his address to the British Association alluded to above, lays great stress on the probable influence of local conditions on the coloring and other external markings of animals, dependent on laws of which we are at present almost entirely ignorant. There can be little doubt that the instances of close resemblance in the vegetable kingdom of which I have spoken are due entirely to similarity of external conditions. When, therefore, we find similar phenomena in the animal world, it would appear more reasonable to attribute them to similar causes, rather than to refer them entirely to a hypothetical process like that of natural selection acting through protective mimicry, in which we are unable actually to follow two consecutive steps.

Mr. Mivart, in his Genesis of Species, and Mr. J. J. Murphy in his Habit and Intelligence have argued, much more forcibly than I can do, against the adequacy of natural selection to account for the phenomena in question; and, lest it may be thought that I am opposing the united view of all our best naturalists, I may remind my readers that so uncompromising an advocate of the theory of evolution as Professor Huxley has stated his deliberate conviction "after much consideration, and with assuredly no bias against Mr. Darwin's views, that, as the

[1] Nature, vol. iii. page 30, November 10, 1870.

evidence stands, it is not absolutely proven that a group of animals having all the characters exhibited by a species in nature has ever been originated by selection, whether artificial or natural." [1]

LONDON, *October* 4, 1876.

EDUCATED FLEAS.

BY W. H. DALL.

IN old-fashioned "annuals" and especially in obsolete works on instinct and intelligence among the lower animals, accounts of the so-called "Educated Fleas" will doubtless be remembered by my adult readers. The story of their marvelous performances had for my boyhood a peculiar interest not unmixed with incredulity. In later years I had begun half-unconsciously to class them with the spurious marvels of the "automatic chess player" and the generation of *Acari* by the action of electricity on chemicals. So far as my mind was occupied with the subject at all, it had concluded on general principles that intelligent action, of the kind described in the old works referred to, could be attributed to fleas with very little probability; and that, whatever the innate mental ability possessed by them, it was in the highest degree unlikely that it was susceptible of training.

Some weeks ago, when passing through Broadway, New York, not far from Union Square, an accidental glance caught the sign over a doorway, "Exhibition of Educated Fleas." Past memories and present curiosity determined me to make an inspection at once. Half an hour later I had seen all there was to see, purchased a lively little pamphlet by — shall I say the *inventor* of the educated fleas? and decided that the small fee exacted was well expended. As it does not appear that the *modus operandi* of this exhibition has ever been explained, an attempt in that direction may not be uninteresting to the readers of the Naturalist.

To make the explanation intelligible it will be necessary to begin with the conclusion, or in other words to first state the essential part of the explanation.

First, the fleas are not educated.

Second, all the performances which make up the exhibition may be traced directly to the desire and earnest efforts of the insects to escape. The means employed to give an appearance

[1] Lay Sermons, page 323 (English edition).

of intelligent action to these struggles are sufficiently ingenious.

In the first place, each flea is attached to some object in such a manner that it cannot free itself, while the movements of its legs and feet are not hindered or embarrassed.

This was explained by the proprietor. The surface of the insect is so polished that no cement will adhere to it when dry, and should a soft or waxy substance be used the insect dies very soon. (A probable cause of this might be the obstruction of the stigmata.) He stated that by tying a single silk fibre around the flea and knotting it on the dorsal side, a bristle, fine wire, or what not, may be cemented to the knot. I was not able to observe exactly where the fibre encircled the insect. This part of the process is the most delicate and difficult to perform.

The proprietor states that female fleas are solely employed by him, since the males are "excessively mulish and altogether disinclined to work." The fact that they are much smaller and weaker than the other sex is probably another and more important reason, and they are said to die in a few days when closely confined.

The first preparation for their task is stated to be as follows: the wild flea is put into a small pill-box with a glass top and bottom, revolving on an axis like a lottery wheel and forming a miniature treadmill. After a few days' confinement herein, the flea, which in a state of nature is, as we know, excessively inclined to jump, becomes broken of the habit. It is said that the constant raps which it receives, when attempting to jump and thereby hitting the sides of its prison, incline it to walk. If this be true, and it might readily be tested by experiment, the flea's education is entirely comprised in it, and, so far as it goes, it is a species of training. I am not yet convinced of the accuracy of the statement. A "wild" flea was shown, attached by one foot to a minute ball and chain, and certainly jumped continually. If a "tame" or educated specimen had been similarly weighted, and had showed no desire to jump, it would have indicated the truth of the theory, provided its legs were found to be sound. This, however, was not done, and all the "tame" ones, having something on their backs, might thereby be affected differently from one confined only by one "foot."

The performances may be divided into two classes: first, by fleas attached to a movable object; and second, by fleas attached to an immovable object. The former (with one exception) are

employed in pulling, pushing, or carrying some object about. This portion of the exhibition is a genuine exposition of the very extraordinary strength in proportion to its size, which is possessed by this little insect. Small and beautifully executed models of horse-cars, vessels, coaches, a wheelbarrow, butterfly, etc., are pulled about, each by a single flea attached firmly to a minute pole or wire, extending from or under the object. Small bits of silk, tissue paper or other light material are attached to the knot on the flea's back, and by courtesy are termed dresses, or equestrians as the case may be.

The proprietor states that the weight of a flea is about 0.05 of a grain, or, if well fed, 0.1 grain. He states that the model of the street car exhibited weighs one hundred and twenty grains or about twelve hundred times the weight of the flea which drags it. Whether these figures be precisely accurate or not, it is a very remarkable effort for so small a creature. Vigorous specimens are said to occur which are able to pull even a considerably larger weight.

The fleas from dogs are less strong than the human parasite, and require more frequent feeding. The ordinary flea will remain four days, it is said, without injury for want of nourishment, and will live for weeks, though diminishing in weight. They are said to live about a year; the performers average eight months, but one is recorded by the proprietor as having lived twenty-three months in his possession, the last two of which were passed in a state of great weakness.

It was noticeable that the surface over which the fleas dragged their burdens was composed of compact blotting paper on which their hooklets took good hold, and that whenever the performance of any one individual was not going on, the particular object to which it was attached was laid on its side, or so that the insect was left, feet in air, where it could not exhaust itself by unnecessary efforts. I think that the absence of any proof of education in the above cases is quite plain.

In the second class of cases the efforts made by the flea to escape are precisely the same, but, being fixed itself, it must necessarily show its power by traction upon some movable object or by aimless gesticulations in the air.

Generally the insect is attached to a sort of style or wire in a perpendicular position with the head uppermost and the limbs extended horizontally. Usually it will remain quiet, but if disturbed by the vibration of its wire, as produced by knock-

ing on the table, it will work its limbs about, seeking something to take hold of. If, then, segments of finest wire, fans of tissue paper, or other representations of objects in miniature are attached to its fore "feet," we shall have it apparently brandishing a stick or sword, fanning, performing on a musical instrument, etc., all of which is much more clearly seen with the aid of a lively imagination.

Two fleas furnished with segments of finest wire on their fore "feet," and placed with their ventral sides so near that the mimic swords can touch, but not the insects' feet, give a representation of a duel not much worse than that usual in most theatres. In their struggles to reach the adjacent object, it would be strange if the little wires did not clash occasionally.

"Madame Lenormand," "Rebekah at the Well," and a flea turning a miniature windmill are brought, each on its perch, so near an endless chain of ingeniously minute workmanship, that their hooklets catch in the links, and they eagerly seize the opportunity of pulling themselves, as they suppose, away from their bonds. The only result is that a little pointer turns to a number on a dial, a little bucket comes out of a well-curb, or the mill goes round. A similar but horizontally applied motion propels a little merry-go-round.

The most amusing and, at first, most incomprehensible of the various performances, is that of the dancing fleas. The orchestra are placed above a little music-box, whose vibrations cause them to gesticulate violently for a few moments, fastened as they are to their posts. Below them several pairs of fleas (fastened by a little bar to each other in pairs, those of each couple just so far apart that they cannot touch each other) are apparently waltzing; an inspection shows that the two composing each pair are pointed in opposite ways; each tries to run away, the "parallelogram of forces" is produced; the forward intention, converted to a rotary motion, ludicrously imitating the habits of certain higher vertebrates.

I have sketched the plan of the performance, and it will be noticed that there is nothing in it which cannot be explained on the hypothesis with which we set out, namely, that all the effects produced may be the result of the natural efforts of the insect to escape, the burden of proof being with those inclined to a contrary opinion. Whatever the result to our opinion of the flea's mental powers, one can hardly avoid admiring the ingenuity with which the "stage property" has been fitted to its purpose, and the beauty of the models and apparatus.

The exhibitor claims to feed his swarm on his own arm, which exhibited a sufficiency of punctures. His whole company may be packed into a shaving-box and put in his coat-tail pocket. He claims to have originated the exhibition forty years ago. Some of the anecdotes in his little pamphlet are amusing enough, and we find the following contributions to the Natural History of the Flea.

"The flea may be easily dissected in a drop of water, and by this means the stomach and bowels may be plainly discovered, with the veins and arteries" (!) Their "amazing motion is performed by means of the great elasticity of their feet, the articulation of which are so many springs, in accordance with the exalted and lofty aspirations of the insect." And finally, "Take a well fed — (*Cimex*) and a starved flea, and place them under a glass together, and you will be afforded an amusing spectacle. The flea as soon as he perceives the pursy condition of the bug will hop upon its back, and, in spite of the latter's struggles to throw him off, will succeed in extracting the blood from the bug's body, leaving it in quite a lean condition, while the flea becomes round, plump, and happy, after its beneficial ride."

THE GIANT BIRDS OF NEW ZEALAND.

BY I. C. RUSSELL.

OF the many remarkable additions that New Zealand has made to the various branches of natural science, none have attracted greater attention, or called forth more exclamations of wonder, than the remains of the giant birds that at no very distant day inhabited those antipodal islands.

In order that we may more fully understand the bearings and relations of our subject, let us glance for a moment at the present inhabitants of New Zealand, many of which are very strange and interesting. Aside from the aborigines, who are an offshoot of the ancient Polynesian family, the first feature that attracts our attention is the total absence of land mammals. The dog and a small species of rat are sometimes spoken of as being natives of New Zealand, but they more likely accompanied the aborigines in their wanderings, or were introduced by the earlier voyagers. The reptiles are almost as great strangers in those islands as are the mammals, being only represented by a few species of harmless lizards, which are very plentiful in individ-

uals, however, in many parts of the country. The position filled by the mammals in other lands is there occupied by the feathered tribes, which reached a surprising development, not only in the living, but more markedly in the extinct fauna.

New Zealand is geologically very old, and probably the remnant of a large continent that has now mostly disappeared beneath the sea; its connection with other lands seems to have been severed before the appearance of mammals on the earth. The birds being the highest form of life on the ancient continent, became concentrated on the remaining islands, which retained many unique and peculiar forms unknown in other portions of the globe.

Like all the islands of the southern hemisphere, the shores of New Zealand are visited by immense numbers of the widely-spread sea-birds, including the great albatross, the largest bird that flies. On the land there are many varied and beautiful forms, including, as in other countries, hawks, owls, pigeons, ducks, etc., together with a large number of smaller birds, as thrushes, starlings, and honey-eaters; among the last is found the beautiful tui or parson bird, as it is often called from the two tufts of white feathers on the throat. Besides these there are other remarkable birds, some of which are very poor of flight, and still others that are wingless, which are peculiar to New Zealand, and of special interest.

Among the numerous parrots the most curious is the kakapo, a large green bird, that, contrary to the usual habits of its tribe, lives on the ground, and, having very poorly developed wings, seldom takes to flight; as it is unable to escape from its enemies, or procure its food in the usual way, it remains concealed during the day in the crevices of the rocks, and is most active during the night.

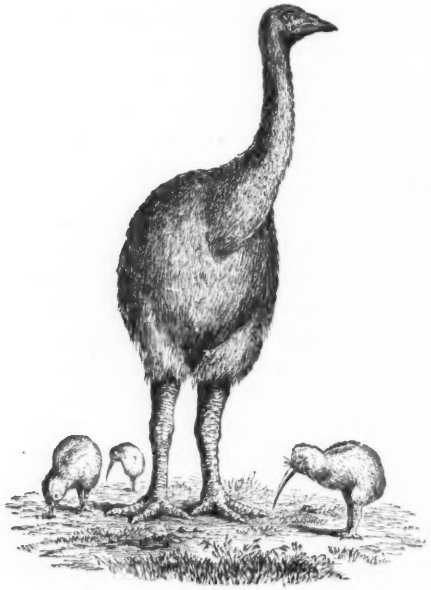
The rails afford a number of interesting species, among which are the weka and the pukeko, as they are called by the natives; these were both very abundant at one time, but are now becoming scarce. The weka, or wood hen, is about the size of a common fowl, of a yellowish-brown color, and inhabits the forest and fern thickets. Its peculiarity is the almost total lack of wings, these being very rudimentary and useless for flight. The weka is the most common of the brevipennate birds of New Zealand, which approach in their habits the character of the lower mammals. The Notornis is another wingless rail, that is especially interesting, as but two individuals are known, which are supposed

to be the last of their race; one of these was captured on the west coast of the South Island and is now among the treasures of the British Museum.

The true wingless birds of New Zealand, however, are the kiwis, of which four species are known; all of these are totally incapable of flight, being, as their scientific name (*Apteryx*) implies, without wings; they have, however, the merest rudiments of wings, that can be felt underneath the feathers. The kiwis, although at one time quite abundant and used by the natives for food, are now the most unique and rarest birds in New Zealand and probably the strangest of living birds. The kiwis are small for the order to which they belong, the Cursores, which includes the ostrich, emu, cassowary, etc., the smaller ones being from fifteen to twenty inches high, while the largest, the roa-roa (*A. maxima*), is the size of a small turkey. They all have strong, well developed legs, depending on their speed for safety; and long bills, which they thrust among the decayed leaves and fern-roots in quest of the grubs and insects that constitute their food. Like the kakapo, they seek their food at night, as they are then exposed to fewer enemies. As is common with the cursorial birds, the kiwis have a loose, hair-like plumage of a dull brown or gray color. Being without wings or tail they have a very odd appearance, looking like a ball of feathers, to which are appended two stout legs and a long bill. We must not fail to notice the size of the kiwi's egg, which is monstrous when compared with the size of the bird, being about five inches in length and weighing usually over thirteen ounces, or one quarter as heavy as the parent bird. Like the other short-winged birds of New Zealand, the kiwis are fast becoming exterminated, not only by the natives, but also by their new enemies, the dogs, cats, and rats, that have accompanied the white man. Wherever the country has been settled by Europeans the kiwis have disappeared, and are now found only in the wild and little-known region along the west coast of the South Island.

Science in her survey of the earth has shown that, as with the trees and flowers, the various orders of animal life are grouped in distinct geographical provinces, in which certain types predominate. Not only does this grouping hold good for the animals of to-day, but embraces, also, the later geological ages, and shows that the ancient forms frequently far surpassed their modern descendants in size. Thus, in South America, where the little armadillos and the sloths have their home, the

geologist has brought to light the remains of the huge Megatherium, that exceeded the elephant in size, and other giant edentates, that inhabited the same land in Tertiary times. In the same marked manner the marsupials which inhabit Australia and Tasmania, to the exclusion of higher forms of life, were preceded by animals of the same structure, but greatly exceeding in size the kangaroo and the wombat of to-day. The same connection holds good between the living and extinct carnivores of Asia, and with the ruminants of North America. In New Zea-



(Fig. 1.) APTERYX AND DINORNIS OF NEW ZEALAND.[1]

land we find the little wingless kiwi preceded by a host of giants bearing the same general form, but whose ponderous frames approached that of the elephant in their development; huge wingless birds, many of them being ten or twelve feet in height, and far exceeding in size and strength the African ostrich, the largest of living birds. These giant birds, that surpass in strangeness the fabulous rocs of Arabian story, were plentiful in New Zealand at no very distant time, and are known to the natives as the moa, and have been grouped by science in two genera, *Dinornis* and *Palapteryx*.

[1] From Tenney's Elements of Zoölogy.

It was the writer's good fortune while stationed at Queenstown, N. Z., in connection with the United States Transit of Venus Expedition, to obtain some of the interesting remains of these huge birds from a cave that we discovered on one of the lower mountains overlooking Lake Wakatipu. Immediately back of Queenstown rises a hill, as it is called in that land of snowy mountains, over two thousand feet high; separated from Mount Ben Lomond by a deep narrow valley, the sides of which are very steep, in some places forming beetling cliffs that are inaccessible even to the wild goats. It was on the side of this narrow valley, eighteen hundred feet from the base of the hill, that the Moa Cave, as we named it, was found. Soon after arriving at Queenstown we heard of the existence of a cave on that portion of the hill and, procuring a guide, we visited it. This cave extended into the side of the hill for a distance of fifty or seventy-five feet, but we found little in it of interest, except a few feathers, which we believe on good authority to be those of the extinct moa, indicating that this cave was very likely inhabited at one time by that bird. Proceeding up the hill to search for other caves, we soon came to a long crevice in the rock, from two to three feet wide, the sides of which were overgrown with ferns; upon parting these and looking down, I could see the bottom of the cave, which descended obliquely, and there to my great delight I saw a large bone projecting from the dirt, some twenty feet below. I lost no time in descending the crevice and securing the prize, which I found to be a huge metatarsal bone of *Dinornis robustus*, measuring 17.5 inches in length, and 6.8 inches in circumference at the smallest portion of the shaft; on further search its companion was found, also a large portion of the tibia and some of the vertebræ of the same individual. Although careful search was made we were unable to find the remaining bones of the skeleton, and were at a loss to know what had become of them. These bones were all well preserved, and seemed to have lost a great part of their animal matter.

On continuing our exploration, we found that the cave first discovered joined another and still deeper one; into this we descended with the aid of a rope, and, groping our way along for about a hundred feet, were rewarded by finding more bones of the moa. In the extreme end of this cave and mingled with dirt, that had evidently fallen from above, we obtained a number of bones belonging to two or three individuals. As the cave at this point was quite narrow, the earth had to be carried back to

a wider portion, which, together with the small space in which to work, made the task difficult; we were rewarded, however, by finding a well-preserved femur of a smaller species of moa, probably *Dinornis didiformis*, and also a perfect sternum, perhaps belonging to the same skeleton, measuring seven inches in length by five in breadth, formed of a single strong, somewhat curved plate of bone, without any indication of a keel, thus forming a striking contrast with the strongly keeled sternum of the eagle and other birds of flight. The most interesting relics that were found in the cave were fragments of the egg-shell of these same birds; the largest piece was about five inches long by three in breadth, and but slightly changed by its long stay in the cave; these fragments were about the twentieth of an inch thick, and covered irregularly with punctures. The largest piece being placed upon an ostrich egg shows it to have belonged to a very much larger egg. A nearly perfect egg of the moa, discovered some years ago, was about ten inches long by seven in breadth, so large that "a hat would make a good egg-cup for it."

In addition, we found in our Moa Cave some small, slim bones which are probably portions of the skeleton of a kiwi; and also an imperfectly ossified bone, about an inch long, lying with the fragments of egg-shell; this we were inclined to think belonged to the "chick" that was once inside of the moa's egg, the fragments of which we had obtained.

The cave where these bones were found was one of a series of nearly parallel rents, that followed for some distance the base of a precipice some two or three hundred feet high, and had evidently been formed by the falling away of a portion of the hill-side, which is composed of mica-schist. That the bones were introduced from above, either by being washed in, or by the birds falling into the crevices, seems evident, for the caves were too narrow and too difficult of access to be inhabited by a bird as large as the moa. That some of the bones fell from above is clearly shown by the fact, that one huge femur had been caught between the side of the cave and a fragment of rock which had fallen in but was too large to reach the bottom; this bone was held so firmly that it was with considerable difficulty we secured it.

There is little doubt that the moa roamed over those mountains after they had received their present form, and the finding of their remains in such an inaccessible place, shows that huge as those birds were, they yet possessed considerable activity, for

it was no easy climb, even for a person accustomed to the work, to reach our moa cave. We also heard of a cave in which moa bones had been found, at a still greater elevation among the Hector Mountains, on the east shore of Lake Wakatipu. Other moa bones were obtained from a cave, but a few feet above the waters of the lake and lower than some of the lake terraces.

The former existence of gigantic birds in New Zealand was first made known in 1839, when a few fragments of their remains found their way into the hands of scientific men in England. Not long afterwards, Mr. Walter Mantell made his well-known discovery of moa bones on the east coast of the South Island. This extensive collection passed into the possession of the British Museum, and furnished Professor Owen with the material for his splendid study of these remains, which were grouped under two genera, *Dinornis* and *Palapteryx*, and these again subdivided into numerous species. The specific distinctions are somewhat difficult to trace, as the bones vary in size; the smallest metatarsal bone in our collection measures 7.5 inches in length and 3 inches in least circumference, while the corresponding measurements of the metatarsal bone of *Dinornis giganteus* are 18.5 and 5.5 inches respectively, — the tibia of the same bird being three feet in length; between these limits there is an almost complete gradation in the size of the species.

In later years numerous discoveries of these remains have been made, both on the North and South Island, and from deposits along the shore that are swept by the tides, to an elevation of five thousand feet or more amid the Southern Alps.

One of the most remarkable deposits yet discovered was at Hamilton, Otago, where from an area of about seven hundred square feet, three and one half tons of moa bones were obtained, for the Otago Museum. As a great number of bones were too much decayed to be collected, this amount indicates only about one half of the total quantity contained in this limited deposit. These bones were found literally packed down in bulk, entirely separated from each other, and mixed indiscriminately throughout the deposit. The place in which they were found seems at one time to have been a lagoon surrounding a spring, to which the moas resorted in great numbers, the bones of those that died being scattered and trampled down by the living birds. Together with the moa bones were found the remains of an extinct goose, and also of an eagle that once lived in New Zealand. The reason for the moas collecting and dying in such numbers at this

one locality is obscure; it has been suggested by Mr. Booth, the discoverer of the fossils, that it was owing to a refrigeration of climate, the birds collecting in this spring for warmth as the winters became more cold. Dr. Hochstetter also obtained, during his visit to New Zealand, valuable moa skeletons from limestone caves in the South Island. These skeletons were found beneath deposits of stalagmite, and were entire, showing that these birds inhabited the caves and had retired there for refuge when death overtook them. Together with these skeletons the ossified rings of the trachea were found, and also little heaps of smoothed pebbles, "moa-stones," which had been swallowed by the moa to assist digestion, in the same manner as the domestic fowl swallows sand and gravel.

The remains of these gigantic birds are not only found in caves and recent river deposits, but also scattered over the surface of the country; although it is somewhat uncommon to find them thus exposed at the present time, yet in the early days of the colonists they were quite abundant, and the little heaps of "moa-stones" were frequently found beneath the ferns. Some years since Dr. Hector observed, near Lake Wakatipu, over thirty skeletons of the moa lying at the foot of a cliff, in the shelter of which they seem to have sought refuge from the storm that destroyed them.

Remains of moa bones, and also fragments of the egg-shells of the same birds have been found, showing the action of fire, and mingled with the charred bones of men and dogs in the ancient kitchen-middens of the New Zealanders. The large bones are also found broken open as if to obtain the marrow; and the egg-shells have been found in the graves of the aborigines. Many other facts have been brought to light by the scientific men who have labored in New Zealand, proving that the moa still existed on those islands after their settlement by man, who introduced a new and higher element into the "struggle for existence" that resulted in the extermination of the moa.

There is but little doubt that the moa, which was once so abundant in New Zealand, furnished the principal food of the natives as they increased and occupied the land. This is the more evident when we remember that those islands furnish little that is sufficiently nutritious to serve as food for man. Nothing like the delicious berries and larger fruits that abound in our own country are found in New Zealand. The food of the natives, at the time of the discovery of those islands, was confined to a kind

of sweet potato, which they had brought with them in their emigration, the succulent root of a fern (*Pteris esculenta*), which, although abundant, is exceedingly indifferent food, together with shell-fish. To these were added the flesh of birds, especially of the "mutton bird" (*Puffinus tristis*), and of seal and fish; then, too, the scanty board was filled out with human flesh. It is not without reason, therefore, that a bird so large, and furnishing so much food as the moa, should be eagerly sought after by the Maoris, and, being unable to fly, and unlike the ostrich, having no desert to flee to, soon became extinct.

The suggestion of Hochstetter that it was only after the extermination of the moa, and the consequent scarcity of animal food, that the New Zealanders were driven to cannibalism, is full of significance.

There are uncertain indications that New Zealand was inhabited by an older people than the present aborigines, a race of "black fellows," as the Maori traditions state, who were exterminated by the more warlike Polynesians. Some consider this older race as the true moa hunters, who exterminated those giant birds many hundred years ago; the active search that is now being made in the ancient cave dwellings of New Zealand, it is expected, will throw more light on this interesting subject.

The adventures of the New Zealand moa hunters, armed with spears and implements of stone, to whom the use of the bow was unknown, must have equaled in wildness and danger the struggles of the Neolithic hunters of Europe with the cave bear or the fierce aurochs. What wild, weird scenes those deep valleys of the Southern Alps must have witnessed, when, after the successful hunt, the natives gathered about their camp-fires, that lit up their dark tattooed faces and shone on the strange vegetation around, to feast on the flesh of the moa, or partake of its huge eggs, roasted on the hot stones of the oven!

How long these birds have been extinct is as yet unsettled. The fact that the bones are found so plentifully, often lying exposed on the surface of the ground, and also the fresh condition of many of the remains, some of which still retain the dried muscles and feathers attached, show that the moa lived at a very recent date, geologically speaking. The Maoris, however, with whom we conversed while in New Zealand, although some of them were cannibals in their youth, had never heard of these birds as living, not even through the traditions of their ancestors. Some of the old legends of the natives, still extant, do contain,

however, references to the moa; it is stated that their long plumes excelled in beauty the crest of the white heron, which is so highly prized by the Maoris.

That the moa not only inhabited New Zealand in great numbers, but also exhibited great variety among themselves, is shown by the differences in the size of the vast number of remains that have been collected. While the larger bones of *Dinornis elephantopus* were short and exceedingly thick and ponderous, the femur measuring nearly eight inches in circumference at the smallest portion of the shaft, the corresponding bones of *D. gracilis* were longer and comparatively slim, indicating a bird of more elegant proportions. The largest of the moas, *D. giganteus*, that stood full ten feet high in its natural position, and could reach to a much greater height, presents a great contrast to the smallest of these birds with which we are acquainted, which could not have been taller than a large turkey.

We have but to greatly exaggerate in our fancy the general form of the wingless and tailless kiwi, to have an accurate idea of their ancient representative. The moa was not furnished, however, with the long, slim bill that the kiwi uses so adroitly in probing the earth in quest of worms, but possessed a much shorter and stronger bill, indicating a more strictly vegetable diet. Its principal food was, probably, the root of the *Pteris esculenta*, which it could easily tear up with its powerful claws.

Besides the various species of Dinornis and Palapteryx, the remains of numerous other fossil birds have been found, not approaching these in size, however; they include species of Apteryx, penguin, albatross, parrot, goose, etc., showing that the feathered tribes have long been the rulers in New Zealand.

During the past few years so much interest has been taken in these fossils that they have found their way into nearly every public museum in the world. Next to the colonial museums of New Zealand, the finest collection of moa skeletons is to be found at the American Museum in Central Park, which consists of a large number of mounted skeletons of different species, including the giant of them all, the *Dinornis giganteus*, the skeleton of which stands about ten feet high; this colossal bird, if living and striding along the muddy shore of some sheltered bay, would leave tracks in the mud as huge as those which excite the wonder of the geologist from the triassic sandstone of Connecticut and New Jersey. Other skeletons of the moa may be seen at the Smithsonian Institution in Washington, and in the Geological Museum of the School of Mines, Columbia College, New York.

While considering the extinct birds of New Zealand, it may not be uninteresting to our readers to turn their attention briefly to the island of Mauritius, the home of the dodo, which is situated about a thousand miles eastward of the coast of Africa, and together with its associated islands presents many features analogous to the life of New Zealand. The Dutch navigators, while making their earlier voyages to the Indies by the new passage around the Cape of Good Hope, found on this uninhabited island large numbers of the clumsy, wingless birds that have received the name of the dodo. This bird which was related in structure to the pigeons, was of about fifty pounds in weight; being totally incapable of flight and very clumsy, it fell an easy victim to the sailors, who killed it in great numbers. Owing to the persecution of man and also, probably, to the depredations of the animals that accompanied him, the dodo soon became exterminated. The only records of its existence which remain are a few of its bones, and the rude drawings and descriptions in the books of the Dutch navigators, together with two or three pictures supposed to have been painted from life. The dodo furnishes the best-known example of the extermination of a species through the agency of man.

Those who would place the extinction of the moa so far in the past will do well to consider the case of the dodo, that, as we have seen, abounded on its native island scarcely two centuries ago, but of which we now know but little more than we do of the moa.

Madagascar, also, had its huge wingless bird, the Æpyornis, that equaled or even exceeded in size the largest of the moas. On the island of Rodriguez another colossal bird, the solitaire, was found, which, like the dodo, has been exterminated by man, and the same fate has befallen other allied birds on the Isle of Bourbon.

It is remarkable that all these huge wingless birds, including also the ostrich and the rhea, are confined to the southern hemisphere, and still more strange that so many of the largest and most interesting of them should be found only on the widely-separated islands of the Indian and Pacific oceans. When and how they came to those isolated islands, or from what ancient forms of life derived, can only be known when the caves and recent rock formations of those islands shall have been explored, and the fragments of the ancient history of these beings deciphered and translated by the geologist.

THE MIGRATIONS OF THE DESTRUCTIVE LOCUST OF THE WEST.

BY A. S. PACKARD, JR.

THE following remarks concerning the probable causes of the migrations of the western locust are extracted from a forthcoming report on this and other injurious insects in Prof. F. V. Hayden's Annual Report of the United States Geological and Geographical Survey of the Territories for 1875. The facts and theories were in part suggested by observations made by myself in Colorado, Utah, and Wyoming, in 1875, while attached for a few weeks to the Survey, and in part by the reports of Prof. C. V. Riley, State Entomologist of Missouri, and by the statements of Prof. Cyrus Thomas, State Entomologist of Illinois, and Hon. W. N. Byers of Denver, and others.

In dealing with this fearfully destructive insect, which has attracted so much notice from the public, and in seeking for remedies against its devastations, it is of prime importance to have a thorough knowledge of its breeding places, the frequency and extent of its migrations, and to seek for the connection between the direction of the winds and other meteorological phenomena, and the flights of the locust.

The locust is quite or nearly as destructive in Africa, Asia, and Southern Europe, as in this country, but the laws of their migrations and their connection with meteorological phenomena have never been studied in those regions, and it remains for the United States, with its Weather Signal Bureau, to institute in connection with the scientific surveys of the West investigations regarding the nature of the evil, and the best means to overcome it.

In endeavoring to trace the connection between the migrations of the locusts and the course of the winds at different months, the writer has been led into some theoretical considerations which seem to be supported by the facts presented in the unpublished report, and which may be confirmed or disproved by future investigations.

History of the Migrations of the Locust. — The following table, compiled from the reports of A. S. Taylor, the late Mr. B. D. Walsh, Prof. C. V. Riley, Prof. C. Thomas, Mr. G. M. Dawson, and the observations of Mr. W. N. Byers, will show the years when the locust was excessively abundant and destructive in the different territories and states, and also serve to roughly indicate the frequency and extent of the migrations of the destructive lo-

cust of the West. The dates which are starred are years when the progeny of the locusts of the preceding year abounded, and when in most cases there were no fresh incursions from the westward. The species referred to under the head of California, Washington, and Oregon may be some other than *Caloptenus spretus*.

Manitoba.	Minnesota and Western Iowa.	Montana and Dakota.	Wyoming and Idaho.	Utah.	Colorado.	Nebraska, Kansas, and Western Missouri.	Indian Territory and Texas.	California.	Washington and Oregon.
1818	1818								1827 or '28
1819	1819								1834 or '35
	1820					1820 or '21		1838	
			1845				1845		
						1846 ?			
			1852	1852			1849		1852
	1855	1855 ?	1855 ?	1855	1855?	1855	1855	1855	1855
	1856*			1856*			1856*	1856*	
1857				1857					
1864	1864	1864			1864				
					1865*				
						1866	1866		
1867	1867			1867	1867	1867	1867		
1868*				1868*	1868	1868*			
1869						1869*			
1872									
	1873	1873	1873	1873?	1873			1873	
1874	1874	1874	1874		1874	1874	1874	South.	
?	1875	1875	1875		1875*	1875*	1875	Cal.	
	1876	1876	1876		1876	1876	1876		

This table and the data on which it is based are necessarily very imperfect, owing to the vast extent of the territory over which the locust swarmed, and the fact that the greater portion is uninhabited, while the inhabited portions have been settled only within comparatively few years.

The Theory of the Migrations. — (1.) *The immediate cause of the migrations of the locust from its original breeding places is the unusual abundance of the species during certain years.* It has been found in some cases that the exceptional years when the locust migrates are periods of unusual heat and dryness, conditions unusually favorable to the excessive increase of insect life. As may be seen in the accounts of the eastern locust, the grass army worm, the grain aphis, the chinch bug, and other less destructive insects, when the early part of the season, the spring and early weeks of summer, are warm and dry, without sudden changes of temperature, insects abound and enormously exceed their ordinary numbers. When two such seasons occur, one after the other, the conditions become still more favorable for the undue

development of insect life. Now it is well known that in the Eastern States the summers of 1860 and 1874, preceding the appearance of the army worm and grain aphis, were unusually warm and dry, and favorable not only for the hatching of the eggs laid the year previous, but for the growth and development of the larvæ or young. Look now at the conditions for the development of locust life on the hot and dry plains, chiefly of Dakota, Montana, Wyoming, and Idaho. We have no meteorological records from these regions at hand, but it is more than probable that the years preceding the migrations of the locusts were exceptionally warm and dry, when the soil was parched with long-sustained droughts, as we know that the corresponding species east of the Mississippi River abounds during dry summers following dry and warm springs.

Given, then, the exceptional years of drought and heat and the great extent of territory, and we have as the result vast numbers of young hatched out. The year previous having perhaps been warm and dry, the locusts would abound, and more eggs than usual would be laid. These would with remarkably few exceptions hatch, and the young soon consume the buffalo grass and other herbage, and move about from one region to another, following often a determinate course in search of food. In this way large broods may migrate a long distance, from perhaps twenty to fifty miles. In about six or seven weeks they acquire wings. Experience shows that the western locust as soon as it is fledged rises up high in the air, sometimes a thousand feet or much higher. They have been seen to settle at night on the ground, eat during this time, and towards noon of the next day fill the air again with their glistening wings. As more and more become fledged, the vast swarm exhausts the supply of food, and when the hosts are finally marshaled, new swarms joining perhaps the original one, the whole swarm, possibly hundreds of miles in extent, begins to fly off, borne by the prevailing westerly and northwesterly winds, in a general easterly and southeasterly course.

(2.) *The secondary cause of the migration is the desire for food, and possibly the reproductive instinct.* The fact that in their migrations the locusts often seem to select cultivated tracts, rapidly cross the treeless, barren plains, and linger and die on the prairies and western edge of the fertile valleys of the Missouri and Mississippi, indicate that the impelling force is due primarily to the want of food, and that the guiding force is the direction

of the prevailing winds, for they have no leaders, and we do not believe in the existence of a "migratory instinct" in the locust any more than in the grass army worm, or the cotton army worm, which it is sufficiently evident migrate from field to field, simply in search of more abundant food. Meanwhile the reproductive system of the locusts is maturing, the eggs ripening, and the uneasiness of the locusts during the course of their travels may be unconsciously stimulated by the sexual instincts and the desire to discover suitable places for egg-laying, a long and tedious operation.

It has been sufficiently shown that a swarm of locusts observed by Professor Robinson near the entrance to Boulder Cañon, Colorado, traveled a distance of about six hundred miles to Eastern Kansas and Missouri. Though the swarm was first observed at some distance north of Denver, Colorado, it was then on its way from the north, and may have come from some part of Wyoming two or three hundred miles northwestward or northward. Though the winds may vary, and counter-currents exist, and storm-gusts from due north, such as often sweep over the plains, and local southerly breezes may retard their flight, the course is either eastward or southeasterly. We know enough of the winds in the Western States and Territories to lay down the law that the general direction of the winds in July and August, along the eastern slope of the Rocky Mountains and on the plains, is from the west and northwest, and accords with the eastward course of the locust swarms. The relations between the average direction of the winds and the migrations of the locust have, however, never been sufficiently studied, either, so far as we are aware, in Europe or in this country. And yet if we would intelligently study the causes of the excessive increase and migrations of the locust, we must examine the meteorological features of the country, ascertain the periods of drought and undue rain-fall, the average direction of the wind for the different months, in order to learn how far they correspond with the phenomena of insect life. That there are meteorological cycles, dry and hot seasons recurring at irregular intervals, while the general average may remain nearly the same century after century, is supported, though it may be vaguely, by observed meteorological facts.

The question then arises; *Can meteorologists predict the coming of seasons of undue heat and drought? and consequently can we predict insect years? that is, the migrations of locusts and the undue increase of the chinch bug, and army and cotton worm?* I

believe that we shall, after the lapse of years, be able to foretell with a good degree of certainty locust invasions, and be able to provide against the losses thus incurred.

On the frontier of the Western States, in Colorado, or in the Territories of Wyoming, Montana, and Utah, where the losses from the ravages of the locust cannot easily be made up by importations from contiguous territories, it seems the most practicable mode to provide in years of plenty against years of want. We should imitate on a grand scale the usage of the ancient Egyptians under Pharaoh, who laid up in times of unusual harvests stores of grain for times of famine. It is said that this has been done on a small scale by the Mormons. If this were done in the far West, in seasons immediately preceding insect years, which had been predicted by entomologists in conjunction with the meteorologists, we should be saved the distress, destitution, and even loss of life from starvation, which have resulted from ignorance of the laws regulating the appearance of destructive insects, especially the western locust.

The Return Migration.— By simultaneous observations for a number of years over the region liable to be visited by migratory hordes of locusts, added to the knowledge we already possess, it will not only be possible to predict the course of certain swarms from their breeding-places, and their probable destination, so that when a swarm starts from Montana or Wyoming, its arrival in Colorado a week or a fortnight later may with some certainty be predicted, and again, its arrival in Kansas and adjoining States be announced with a certain amount of precision, as has already been done by Dr. Riley, but we shall be able to foretell the course taken in the return flight of their progeny in the succeeding year. I will confess that previous to my visit to Kansas and Colorado, in 1875, I was skeptical as to Dr. Riley's opinion that there was a general movement in a northwest course of the young of the previous year, broods from Missouri and adjoining regions northwestward. The facts and resulting theory have already been stated in full by Dr. Riley and others. It remains to determine the causes of this return migration, this completion of the "migration-cycle," as Professor Dawson terms it. It is evident that in this case the desire for food is not the cause, for food is many times more abundant in the Mississippi Valley than on the plains whither they return. The solution of the problem, I think, must be sought in the direction of the prevailing winds during the middle of June, the time when they become winged.

It may be found after a series of careful meteorological observations, that the prevailing winds at this early season are southerly and southeasterly. It has been shown by meteorologists, as I learn from Prof. C. Abbe, that during May and June the winds blow inwards towards the heart of the continent from the Atlantic Ocean and Gulf of Mexico. On application to Gen. A. J. Myer, Chief of the Signal Service of the United States Army, for the meteorological data necessary to confirm this hypothesis, I promptly received a full summary of data observed by the officers of the Weather Signal Bureau, for periods of from two to five (usually the latter) years between 1871 and 1876, which show that the prevailing winds in June, in Davenport, Dodge City, and Keokuk, Iowa; Saint Paul and Breckenridge, Minnesota; Yankton and Fort Sully, Dakota; Omaha, Leavenworth, and Fort Gibson, Indian Territory, — all within the locust area, — are from the southeast and south. This fact may be sufficient to account for the prevailing course of the return migrations of the locust from the eastern limits of the locust area.

Let us therefore grant this setting-in of southerly and easterly winds, which may last until the locusts are winged. When they rise on the wing into the air they are known to move in a general northwest direction. It is highly probable that they are borne along by these generally southeasterly winds, and pass over on to the plains. The cause is seen, then, to be entirely independent of subsistence; possibly the reproductive instinct causes them to become uneasy, restless, to assemble high in the air and seek the dry, hot, elevated plateau of the northwest. Should this be so the cause of their migrations is probably purely mechanical. Abundant testimony is at hand to show that they are wholly at the mercy of the prevailing winds, and that as a rule the course of their migrations is quite dependent on the direction of the winds, while the course of the winds depend more or less on the season of the year. We may expect that future research over sufficient territory will show that the June migrations, from the eastern limits of the locust area, will be towards the northwest, and the July, August, and early September migrations, from the Rocky Mountain plateau, will be in a general easterly and southeasterly direction.

It is not only of great scientific interest, but of high practical importance, to collect all facts bearing on the return migrations, in order to know where the locusts go in their return migrations the second year, as we only know that they do fly a certain dis-

tance northwestward. We want to ascertain the extreme western limits of this return migration. We also want to learn whether they return to their original breeding-places on the eastern slopes of the Rocky Mountains, or whether the westerly winds, if they are westerly, drive them back and scatter them, so that they do not breed extensively.

It will be seen by the reader that all grounds for a reliable working theory of locust migrations are based on the work of our Signal Bureau and local observers, and that the observations of the meteorologists and entomologists must go hand in hand. The government has provided a well-organized corps of meteorological observers, and we submit that a number of competent entomologists should take the field, under government auspices. Not only should the border States, especially Texas, Kansas, Nebraska, Minnesota, and Iowa, employ competent entomologists, following the liberal policy of Missouri, which for eight years has had a state entomologist, whose reports have proved of incalculable practical value, as well as of great scientific interest, but the habits of the locust need first of all to be thoroughly studied in the Territories, particularly those of Wyoming, Montana, Idaho, Dakota, Utah, New Mexico, Arizona, and in the State of Colorado. A commission of entomologists should be appointed to make a thorough detailed study for several successive seasons of the habits of the locusts in the Territories mentioned. It would seem that the recommendations made at the recent meeting of Western governors at Omaha, that an appropriation be made by Congress, and a commission be attached to the existing United States Geological and Geographical Survey of the Territories, is the most feasible and economical method of securing the speediest and best results.

Let us for a moment look at the losses sustained in the United States from the attacks of insects. The annual agricultural products of this country by the last census amounted in value to $2,500,000,000. Of this amount we in all probability *annually* lose over $200,000,000 from the attacks of injurious insects alone. Dr. Riley avers that the losses during 1874 in Missouri from locusts, and it will be remembered that only the western third was invaded, exceeded $15,000,000. This would make the losses in other parts of the West at least twice as much more, or $45,000,000 in all. The estimated money loss occasioned by the chinch bug in Illinois in 1864 was over $73,000,000; in Missouri in 1874, it is estimated by Dr. Riley to have been

$19,000,000. The annual losses from the chinch bug are greater, Mr. Riley says, than from any other insect. The average annual loss to the cotton crop from the attacks of the cotton army worm alone is estimated at $50,000,000. Adding to these the losses sustained by the attacks of about a thousand other species of insects which affect our cereals, forage and field crops, fruit trees and shrubs, garden vegetables, shade and ornamental trees, as well as our hard and pine forests, and stored fruits, and it will not be thought an exaggeration to put our annual losses at $200,000,000. If the people of this country would only look at this annual depletion, this absolute waste, which drags her backward in the race with the countries of the Old World, they might see the necessity of taking effectual preventive measures in restraining the ravages of insects. With care and forethought based on the observance of facts by scientific men, we believe that from $50,000,000 to $100,000,000, or from one quarter to one half of this annual waste, could be saved to the country. And the practical, most efficient way is for the States to coöperate with the general government in the appointment of salaried entomologists, and of a United States commission of entomologists, who should combine the results of the state officials, and issue weekly, or, if necessary, daily bulletins, perhaps in combination with the Weather Signal Bureau, as to the conditions of the insect world, forewarning farmers and gardeners from week to week as to what enemies should be guarded against and what preventive and remedial measures should be used.

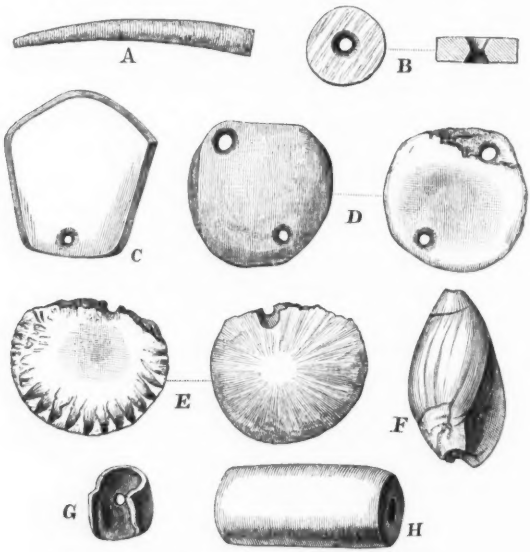
The Weather Signal Bureau, first suggested and urged by the late I. A. Lapham, was not instituted without ridicule and opposition, but it has saved millions to our commerce and agriculture. The maintenance of an entomological commission and the appointment of state entomologists would involve comparatively little expense. Already, owing to the full information regarding the invasion of Missouri by the locust in 1874, contained in the reports of Prof. C. V. Riley, the people of that State will be well prepared from the direful experience of the past, to deal more intelligently and efficiently with the locust in the future.

NOTES ON THE ABORIGINAL MONEY OF CALIFORNIA.

BY LORENZO G. YATES.

THE material used by the aborigines of California for purposes of exchange, and as media of circulation, are shells of mollusca, and rocks made into forms generally resembling beads or buttons. The *Dentalium* (Figure 2, A) is used by the Indians of the north. Large numbers have been imported from Europe for trade with the Indians.

The shell of *Saxidomus aratus* Gld. or "clam-shell," is broken into pieces of suitable size, and worked into flat circular

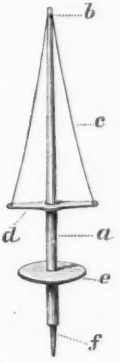


(FIG. 2.) ABORIGINAL MONEY OF CALIFORNIA.

disks, by rubbing upon a flat sandstone rock (which at some of the "Rancherias," or settlements, has to be brought from some distance). A hole is drilled through the centre and when finished (Figure 2, B) they are strung on strings. Among the Indians of Lake County eighty of these disks are valued at one dollar. The drill stock is formed as follows. (See Figure 3.) The shaft is about thirty inches long and formed of a straight stick somewhat tapering, *a*, about three fourths of an inch in diameter at the bottom or larger end. A hole is made through the upper end of the shaft, *b*, through which is passed a buckskin string about

three and a half or four feet long, *c*, the ends of which are fastened to the ends of a cross-bar, *d*, about eight inches long, in the centre of which is a hole through which the shaft plays easily. A circular wooden disk, *e*, serving as a fly-wheel, is fastened on the shaft about four inches from its lower end.

In using the drill, which is inserted in the lower end of the shaft, *f*, the loose cross-bar (to the ends of which the buckskin string is fastened) is twisted around the shaft a few times, the drill placed in position, the fingers of the right hand resting on the loose cross-bar, *d*, and on both sides of the shaft, *a*, when, by a quick downward pressure on the cross-bar the shaft is made to revolve, and receive sufficient impetus to *untwist* the string from the shaft, and twist it around in the opposite direction, rotating the drill to the right and left, the holes being drilled from both sides.



(Fig. 3.) DRILL.

The shell of the "abelone" (Haliotis) is formed into pieces resembling "key-stones" (Figure 2, C) and circular disks, plain as in Figure 2, D and ornamented as in Figure 2, E; these appear to be used also as ornaments for baskets, and worn on head-dresses, necklaces, etc.

The shell of *Olivella biplicata* Sby. is also (or was) used as money, the writer having found them occasionally in the "mounds" of Contra Costa and Alameda counties, mixed with the small flat disks described above.

They were made, first by rubbing the apex of the shell on a stone until a hole is made large enough to receive a string which is passed through the shell parallel with its axis (Figure 2, F); or by breaking the shell and using the pieces of the larger whorl, in the same manner as the disks made from the Saxidomus. (Figure 2, G.)

The "Gold Coin" of the aborigines is a long bead made of a peculiar kind of rock, the locality of which is kept secret by the Indians; it appears to be a magnesian silicate, beautifully banded or mottled; the colors being white, brown, and yellowish, the former color predominating. The writer having been unable to obtain even a fragment in its natural state, all the specimens seen having been subjected to the action of fire, either before being worked out, or previous to being polished, does not feel satisfied as to its mineral character. The money made from this material is of a cylindrical form (Figure 2, H), about three fourths

of an inch in diameter, and from one to three inches in length, with a hole drilled through lengthwise. They represent a money value of from $2.50 to $25.00, according to their length and beauty of finish and coloring. From the hardness of the material and the rough tools with which they are made, their manufacture must require a great deal of time and patience.

While exploring a mound in Contra Costa County several years ago, the writer found the charred remains of a human skeleton some two feet below the original surface of the soil under the mound, and with it a large and elaborately worked pestle, with a number of coins or beads similar to Figure 2, G mixed with red paint, and fragments of others similar to Figure 2, H. The body had evidently been burned with the beads, and the pestle purposely broken into several pieces; nothing else was found with the remains, except fragments of charcoal mixed with the surrounding soil.

The Indian females wear all the money they can command on the occasion of a "big dance" or other public gathering; but during a visit to the Lake country some years since, the writer had an opportunity of examining a common trunk filled with money and ornaments belonging to a squaw, who was married to a white settler (a common occurrence in that country); the inspection was made without the knowledge of the owner, who would probably have objected to it; the larger portion of the contents of the trunk consisted of money like Figure 2, B with a few like Figure 2, H interspersed.

THE PHILOSOPHER'S STONE.[1]

BY WILLIAM E. HAGEN.

A REVIEW of the history of alchemy will show that the effort made by it to produce gold artificially may be understandingly connected with certain phenomena found associated with gold in nature, and which may be reasonably supposed to have suggested such an undertaking.

From the early authors of Hellenic literature investigation first learns of alchemy as a pursuit of man, and as originating in ancient Cushite Arabia, amongst a people who had then been famed for great wealth in silver and gold for many ages, and of

[1] Abstract of a paper read before the Troy Scientific Association, February 21, 1876.

whom we are told that they had possessed the art of making gold from the earliest times. While we may look with wonder at the almost incredible accounts of their wealth, and still doubt the fact of their having made gold artificially, yet we are compelled to accord to them a high state of civilization, and the possession of as much knowledge in metallurgy specially considered as we ourselves own. We must also admit that in this branch of acquired learning they were in some respects our superiors, particularly in the treatment of copper. With all the evidences of their knowledge in this branch of science we may not consistently laugh down the effort made by them to produce gold from other metals, for this problem was suggested to an intelligence in connection with metallurgical operations fully equal to if not superior to our own.

So far as any large accumulation of gold is concerned, we can reasonably infer that its aggregation did not call for any great display of knowledge, for gold is always found in a metallic state, and its melting and working can be performed by the simplest of metallurgical operations. All we have to do to account for such a condition of accumulation is to suppose that some great source of supply existed of which all traces have now disappeared. We know that there were two avenues open for the collection of gold, the Ural Mountains and the sands of Africa. But they were also rich in silver, and to such an extent that they made their household furniture of it, also using it in connection with gold, to form the caps of columns that adorned their homes. Silver, unlike gold, is seldom found in a metallic state, and it is in fact separated from the ore only by a complicated effort of metallurgical chemistry, and one that requires much more than ordinary melting skill.

It was amongst a people thus skilled in the working of metals that something had been found to suggest the idea that gold could be produced by transmutation, and to learn if we can what there is in nature likely to prompt such a problem is the object of the present paper. Gold is ordinarily found in river gravels and sands, as well as at the bottoms of gulches, whence the greater bulk of the gold produced has been obtained. It is usually separated from the lighter sands and gravels by washing, to accomplish which invention has produced about the same appliances the world over.

Placer gold, as alluvial gold is called, is well understood to be not an original condition of the metal, but a secondary one, and one which has found a new place of repose some distance from

the matrix that formerly held it. All alluvial gold has been liberated from the mountain veins by the crumbling and disintegration of the tops of the elevations, and where erosion has taken place, the gold, which is indestructible in nature, has been set free from the original environment in the vein which held it, and by reason of its greater gravity has descended beneath and through the soil upon the mountain-side, along the inclining face of the rocky slope, until it has reached the lower level of the river or gulch bottom. No salts of gold being found in nature, the surface of the metal is always bright and clean, and, being so soft, ductile, and heavy, its particles adhere by contact to form nuggets. Sometimes an interposing shelf or ledge upon the hill-side will arrest and detain the descending particles until aggregations of a larger size are formed. Such places are called pockets. The breaking away of such a shelf, and the subsequent descent of the gold thus aggregated, by means of gravity, to the lower level of the river bed, accounts for the occasional appearance of the large masses of gold found in river bottoms. The particles of metal occurring in the lower portion of the slope will uniformly be coarser than those obtained higher up, from the effects of aggregation in their passage; and they also begin to show the worn appearance of alluvial gold, from having been carried along over the rough surface of the rocky hill-side in their descent towards the river bed.

Supposing some ancient seeker after the precious metal to have exhausted the supply of a locality by washing the gravels and sands of a river bottom, in following up the hill-side the traces of the descending gold, he would in removing the soil eventually reach a place where all signs of gold would have disappeared. At this point, as he exposed the surface of the mountain-side, he would find a vein of quartz; and this at the top would be much decomposed, having a honey-combed or cellular appearance. Adhering to the quartz, and in some of its cells, he would find particles of gold, and as he made an opening into the vein he would expose to view what we term sulphides of iron and copper, as well as cells containing oxides of these metals, and also gold. When he came to deepen the opening upon the vein, all signs of gold would disappear, and he would find nothing but the quartz and accompanying sulphides. He would hardly suppose the latter to be gold, but, as he found the two to be neighbors, he might infer that the one contained the other, and to settle the question he would call into requisition the services of

his melting friend, fire. When the sulphides were heated, they would give off the fumes of sulphur, and would form oxides of iron and copper, which, though he might not recognize them by these names, he would identify as the same substances that he found in the cells of the quartz with the gold. When he came to wash the product that the fire had made from the sulphides, and found there was no gold, he would be much surprised. But his faculties of perception are very keen; he has them to depend upon, and no books or so-called schools of mines to go to for information, and he has learned to study nature by looking at her square in the face. Now we will suppose him, under such conditions of mental capacity, to be examining a piece of quartz in which there are two features of particular interest in this connection, and these features found to consist of two well-defined cubiform cells which have been opened by the fracture of the piece, and which before its rupture were hermetically sealed, and inclosed within the quartz matrix. These cells both appear to have been shaped by the same agency, the crystalline form of the sulphides. One of the cells is filled with the sulphides, the other contains oxides of iron and copper, which he recognizes as the substances produced from this material by the fire; and with them, within the cell, as it appears, is a small aggregation of gold. He properly assumes that the square form of the cells has been given to them by the crystalline form of the sulphides, and that the latter was the first occupant, and made the cell. How did the sulphide get out, so that the gold could move in, when all the approaches to the cell were sealed up by the surrounding quartz matrix? He reasons that since it could not get out, or the gold move in, the former substance and occupant has been changed, and produced the new-comer, gold.

When these phenomena as presented to ancient alchemy are also before us, we, who claim to be much wiser than the old alchemists, have a way of settling the matter; and we proceed to analyze the sulphides, and from them we do get a trace of gold, though not one ten thousandth proportion of the amount existing in the other cell. We have learned that to investigate any chemical fact, we must take nothing for granted if we seek the truth; and right here, when we fancy we have unraveled the whole mystery, we are met with the troublesome query whether the trace of gold that we have found may not be due to a metamorphosis commenced in the one, and completed in the other; for the amount we have found in the one is but a trifle, compared

with that existing in the other. Growing earnest in our perplexity, we again select with care such portions of the sulphides as we may believe to be in a condition of repose, and make several trials more. Some of the selections do contain a trace of gold, and others do not; but whenever we analyze a piece that shows any evidences of oxidation, and ascertain that the quantity of gold found increases in proportion to the progress of the oxidation very rapidly, we come to the conclusion that we are little better off than the ancient alchemist after all, and we have learned to respect his deduction though we hesitate to accept his facts. We are a little too conservative and careful to jump at his conclusion, but we really feel that we do not require much more persuading to adopt his theory, and we are almost ready to believe that gold may exist in nature as the result of the metamorphosis we have been examining and discussing.

Alchemy found out one leading element which it associated with the assumed production, and that is sulphur; so for centuries this substance has been coaxed, wheedled, and implored to do for alchemy what it seemed to do in nature. But all of man's efforts to harness it into the work are futile, and finally the work has been abandoned, but not until the glittering incentive had led alchemy to perform all the drudgery of elementary chemistry.

Various specimens of ore, exhibited by the speaker, from all the different gold-producing areas of this country, exhibit in different degrees the suggestive phenomena described. Interestingly connected with the elucidation of the proposed hypothesis, are two specimens from the same mine in North Carolina, one of them showing the cell formed in a dense mass of the sulphides, and the other a commencement of the assumed evolution. Both of the specimens are fragments of massive sulphides of iron and copper, and within the cell opened by the fracture of the piece is a nugget of gold, surrounded within the cell by the oxides. Upon the other piece, and where the assumed evolution has commenced, the vitreous and glassy surface of the sulphides has been changed, and a thin film of gold coated the crystals. On some of the faces of them, and on such surfaces of the crystals as sloped downwards, the gold has begun the process of aggregation, is thicker at the bottom of the slope than at the top, and when examined with a microscope distinctly exhibits the fact that the film has thickened upon the lower edge of the inclined surface, under the influence of gravity. The average value of these sul-

phides in the gold, as determined by over thirty carefully made assays, was about ten dollars per ton, the selections for assay being made from such material as seemed nearest to a state of repose.

Wherever decomposition had occurred in the deposit, the yield of gold increased at a large ratio. One bushel of the decomposed sulphides, consisting of oxides and gangue, produced, as the writer was informed, over eighteen hundred dollars; this was said to have been found in a small cavity formed in the vein from the decomposition of the sulphides. An examination of the specimen containing the gold shows that the decomposition of the sulphides to form the cell has been in proportion to about nine times the bulk of the gold and oxide occupying the cell.

Careful examination was made of some twenty tons of this ore, to see if any free gold existed in the sulphides, apart from the evidence of decomposition. This ore was all broken up, and a close inspection failed to find any such appearance within it.

All the quartz veins containing gold in the absence of the sulphides, and as occurring in some parts of California and Montana, are of a more recent formation than the others, and if the gold so existing be examined with care, it will be found to contain unmistakable evidences of being water-worn, as if it had been liberated from an older matrix, and had been washed into the crevice with the silicious solution which filled it. Another fact favoring this deduction is that where such veins dip, the gold is nearly all found at the foot wall, and the quartz upon the upper inclined side of the vein is barren.

Amongst other specimens shown to sustain the hypothesis is a piece of baryta or heavy spar. This contains a large nodule of oxide of iron, with a trace of its former existence as a sulphide present in it. The oxide is full of gold, yet there is none in the baryta apart from this connection with the oxide of iron.

A very interesting form of gold is taken from a vein of tough ferruginous aluminous clay existing in various parts of the Southern States. The gold in this deposit is very singularly aggregated, and the metal is not at all worn by attrition, like alluvial gold, but appears in the form of threads, nodules, and cubes, some of the threads being very delicately joined, as if made where it was found and never disassociated from the old connection of the sulphides in the way of the oxidized skeletons of a former crystallization. Masses weighing five pounds have been found in this deposit. Dr. James Crump, of Montgomery County, North

Carolina, had in his possession many curious forms of gold taken from this clay; one particularly so in the fact that it represented a beetle, and this similarity was not one that taxed the imagination at all to see the resemblance. It looked just as though the insect had been entombed in the clay, and the fine particles of gold had insinuated themselves into the cavity, to there aggregate and take the shape of the insect that it displaced, the lines of the sheath upon the back being as plainly delineated as they are upon a real insect. He had also gold in the form of leaves upon the laminæ of slate, where the gold had drifted in between the foliations and taken the place of the cellulose. All the gold found in this clay was of a peculiarly fine quality.

To such as believe in evolution, the hypothesis seems possible, although we know in the laboratory that gold seems the most positively elementary substance of the metallic series. But many are led to believe that matter in the various forms of environment which we dignify with the name of elements has all been evolved from some simple form of substance that once composed the primeval cosmos. It seems to assume no more annihilation of elementary stability to assert that gold is of a derivative origin than it does to believe, as some now do, that bog iron ore (with iron a so-called element) is evolved from the life of the *Gallonella ferruginea*.

RECENT LITERATURE.

Gurney's Rambles of a Naturalist.[1] — Although not specially interested in ornithology, we have been led on from chapter to chapter until all except the special notes, which take up a considerable portion of the book, have been conned over, and we have been led to regard the work as a very pleasant record, by an observing and evidently experienced ornithologist, of travels in some of the most interesting regions of the Old World. Mr. Gurney discovered but one bird absolutely new to Egypt, the lesser white-fronted goose, and this not a "new species." We much relish a foot-note on page 110, in which it is said that "quite seven tenths of the names which have been bestowed on 'new birds' within the last few years have already sunk into synonyms, and the advance of science has thereby been impeded." This evinces sound ornithology in the author! One chapter is mostly devoted to the sacred ibis. An extract will give some idea of the author's style. "Alas! alas!

[1] *Rambles of a Naturalist in Egypt and other Countries.* With an Analysis of the Claims of certain Foreign Birds to be considered British, and other Ornithological Notes. By J. H. Gurney, Jr., F. Z. S. London: Jarrold and Sons. 12mo, pp. 307. For sale by S. E. Cassino, Naturalists' Agency, Salem, Mass.

the sacred ibis is no longer found in Egypt. What would the shaven priests say if they could live over again? My humble opinion is that they would say that in their wild state they never were anything but rarities, and confirm the theory of Dr. Adams[1] that they were imported from the south. I look upon them as an imported exotic, for I cannot conjecture what natural cause can have operated upon them to produce their extinction, if they ever were natives. They were domesticated, in time they became totally dependent on man, Egypt was conquered by another nation, the hand of protection was withdrawn, and the breed died out." Savigny while in Egypt saw one sacred ibis alive. "Its extinction, therefore, must be of comparatively recent date. Fortunately it has not been extirpated altogether, like the great auk and the *Nestor productus*. It is still common in more southern regions, though driven from its stronghold in Egypt." Concerning animal life in Egypt the author thus pleasantly discourses, and with this extract our notice closes: "While my attendant is rolling a cigarette, I pause a moment to wonder what goal all the thousands of pale Egyptian swifts which are careering by can have. They pass by, but there is no check; others take their place. Can they who press on with such steady purpose stop short of Europe? Their heads are all to the north; they are flying low, like birds with a settled object. Less numerous, but still innumerable, and with the same aim, and flying in the same direction, I see a cloud of sand martins. At the rate they are now going they will soon be decimating insect life at Cairo, and banking over the pools of El Tostat, in conjunction with the rufous-breasted swallow and its distinct English congener. But all Egyptian birds are not migrants. There are the stay-at-homes, and one of these is the hooded crow, which sits in the sycamore-fig, announcing with loud caws, to all who may be interested in the fact, that she has laid her eggs; and another is the parasitic greater spotted cuckoo, which chuckles at the thought of having added one to the number. These belong to a class which is divisible into flats and sharpers — birds who 'do' others or are themselves 'done.'

"In the long grass the fantail builds her gem of a nest, and the *Drymœca gracilis*, another minute warbler, chirrups to her young ones, 'branchers' already with little bodies and no tails.

"Small rodents spring into the ditches, lizards scuttle up the walls of houses, the moving snake eyes the fledgeling, and the sly fox trots away among the tobacco plants. So great is the overflow of animal life that no one can fail to be struck by it. Only those can appreciate the scene in its zoölogical aspect who are capable of discriminating between the many species, though all can and must listen with unmixed feelings of pleasure to the chanting of the choristers and the hum of many insects, and all must feel the balmy air and fragrant luxuriance of foliage and blossom, and derive enjoyment from the view before them,

[1] Ibis, 1864, page 32.

the rock-cut tombs, the tents, the camels, the Bedouins with their long guns, the lateen sails upon the river, and the mountains in the hazy distance.

"I shall be pardoned if I next submit a brief companion picture of the prominent species to be met with in June at such a lake as the Faioum (Birket-el-Korn). First, the little long-tailed African cormorant goes by with straight, undeviating flight, like one who knows what place he wants to go to and is going there, leaving behind him the wanton terns, who have no object in life but lightly to sport over the water as they watch for their finny prey, assured that the warm sun will take care to incubate their eggs. In noisy conclave the buff-backed herons trim their nests, and the shyer squacco is uneasy at any disturbance the meaning of which he does not understand, while the cautious egret takes his stick away again, wisely jealous of revealing the whereabouts of his yet unfinished edifice. The Dalmatian pelican swims away with all sail set, or flaps and glides and flaps and glides over the water, his huge form mirrored on the surface, startling the basking fish, which hurry from the presence of their enemy. Marbled ducks in pairs rise from among the sedges; agile grebes put their trust in diving; the tall reeds quiver as the green-backed porphyrio seeks their friendly shelter; the reed warbler sounds a loud alarum. All fly to the nearest cover and in those thick beds they find a secure haven."

Boucard's Catalogue of Birds.[1] — This useful list gives the names and localities of all known living birds, numbering 11,030 species in 2456 genera, though in the author's opinion "many of these genera and species must be eventually abolished." The subgenera are placed as genera, and M. Boucard believes that it does harm to ornithological science "to multiply the genera and the subgenera, as it has been the practice to do lately." The classification followed is a new one, beginning with the *Struthiones*, the lowest living forms, and ending with the humming-birds, which the author regards as the most recent and probably the most perfectly organized birds. Four new "orders" are proposed, namely, *Palamedeæ* for *Palamedea*, *Chauna*, and *Ischyornis*; *Pterocles* for the *Pteroclidæ*; *Phœnicopteri* for *Phœnicopterus*; and *Trochili* for the humming-birds. As a check-list for exchanges and arranging museums we doubt not the book will be found to be very convenient.

The Wild Flowers of America.[2] — It is a singular fact that many of our more common and beautiful wild flowers have never been figured, and we are glad that in the present series an attempt is to be made

[1] *Catalogus Avium hucusque Descriptorum.* Auctor Adolphus Boucard. Londini. 1876. For sale at 35 Great Russell Street, London, W. C.; and by S. C. Cassino, Salem, Mass.

[2] *The Wild Flowers of America.* Illustrations by Isaac Sprague. Text by George L. Goodale, M. D., Assistant Professor of Vegetable Physiology, and Instructor in Botany in Harvard University. Part I. Boston: H. O. Houghton & Co.; New York: Hurd and Houghton.

to supply the deficiency. The present fasciculus, which forms the first part of a work of which it is intended that two parts shall be issued annually, contains colored plates of *Aquilegia Canadensis* L., *Geranium maculatum* L., *Aster undulatus* L., *Gerardia flava* L., and *Gerardia tennifolia* Vahl. The artist, Mr. Isaac Sprague, is well known by his excellent outline drawings in Gray's Genera and in the botanical reports of several of the western surveys. The present plates are accurate in drawing and brilliant in color, that of the columbine being especially striking. The two species of Gerardia are figured on the same plate, but, although this is perhaps an advantage in a botanical point of view, it must be confessed that the general effect is not pleasing.

Accompanying the plates are twelve pages of text by Prof. G. L. Goodale. The task of describing plants which have a popular interest, as in the case of the species figured in the present fasciculus, is by no means easy or gracious. The writer is too apt to confine himself to vague sentimentalities. This danger Professor Goodale has successfully avoided, and instead of copious extracts from Mrs. Hemans and Wordsworth he has, very much more to the purpose, given quotations from Hermann Müller and Sprengel, writers who, although by no means unfamiliar to those who have taken a botanical course at Cambridge, are probably new to the majority of those who purchase the present work. If Mr. Sprague has made the Wild Flowers of America a work which will be sought by all lovers of the beautiful, Professor Goodale has done no less for those who seek instruction, pleasingly conveyed, with regard to our common native plants. The price, $5.00 a part, seems rather high, but if, as we learn from the publisher's announcement, the first edition is already nearly exhausted, it cannot be said to be too high.

Recent Books and Pamphlets. — Synopsis of American Wasps. By Dr. H. de Saussure. Solitary Wasps. (Smithsonian Miscellaneous Collections. 254.) Washington, D. C. 1875. 8vo, pp. 385.

Studien zur Descendenz-theorie. II. Ueber die letzten Ursachen der Transmutationen. Von Prof. August Weismann. Leipzig. 1876. 8vo, pp. 336. 5 plates.

Seventh Annual Report of the Geological Survey of Indiana, made during the Year 1875. By E. T. Cox, State Geologist, assisted by Prof. John Collett, Prof. W. W. Borden, and Dr. G. M. Levete. Indianapolis. 1876. 8vo, pp. 601.

Entomologische Nachrichten. Herausgegeben von Dr. S. Katter. Jahrgang I. 1875. II. Heft i., ii. 1876. C. F. Vieweg in Quedlinburg. 8vo.

Recherches sur les Dicyemides, Survivants actuels d'un Embranchement des Mésozoaires. Par Édouard Van Beneden. Bruxelles. 1876. 8vo, pp. 111. 3 plates.

Our Present Knowledge of the Nidification of the American Kinglets. By Ernest Ingersoll. (From the Bulletin of the Nuttall Ornithological Club. Vol. i., No. 4. November, 1876.) 8vo, pp. 80.

Descriptions of some Vertebrate Remains from the Fort Union Beds of Montana. By E. D. Cope. (Extracted from the Proceedings of the Academy of Natural Sciences of Philadelphia, October 31, 1876.)

Increase Allen Lapham. A Memorial. Read before the Wisconsin Natural History Society. By Charles Mann. 8vo, pp. 21.

The Land-Birds and Game-Birds of New England. With Descriptions of the

Birds, their Nests and Eggs, their Habits and Notes. With Illustrations. By H. D. Minot. Salem, Mass.: Naturalists' Agency. Boston: Estes and Lauriat. 1877. 8vo, pp. 456.

GENERAL NOTES.

BOTANY.[1]

Homogone and Heterogone (or Homogonous and Heterogonous) Flowers. — That difference in relative length or height of stamens and style, reciprocally, which in Torrey and Gray's Flora of North America was very long ago designated by the term *diœco-dimorphism*, Mr. Darwin, who detected and has made much of the meaning of the arrangement, called simply *dimorphism*. Besides these *dimorphic*, he also brought to view *trimorphic* flowers. The first name is too long for use and carries with it some ambiguity, since it may imply a separation as well as a diversification of the sexes. Mr. Darwin's term has the disadvantage of not indicating what parts of the blossom are *dimorphic* (hermaphrodite flowers may be dimorphous in the perigonium), and a more generic name is now required on account of trimorphic, etc. This has been supplied by Hildebrand in Germany, who has introduced the term *heterostyled* and the counterpart *homostyled*. These are not particularly happy appellations; for the difference is in the stamens as well as in the pistil, and in the latter is not always restricted to the style. Well-established terms ought not to be superseded on the ground of improvement; but those which have not yet taken root sometimes may be. Following the analogy of *perigonium* or *perigone*, I propose the more exactly expressive term of *heterogone* (or *heterogonous*), for these flowers such as those of *Primula*, *Houstonia*, *Lythrum*, etc. The counterpart *homogone* (or *homogonous*) would designate the absence of this kind of differentiation. These terms, either in Latin or English form, would work well in generic or specific characters, and have the advantage of etymological correctness. —Asa Gray.

A Madroña swallows an Oak! — "Being yesterday in the country in this neighborhood, I saw what seemed to me a curious botanical phenomenon, which may be of interest. The phenomenon is this. I found in San Rafael, growing side by side, almost from the same root, a Californian oak and a madroña, but on examining the madroña, I found that inside of it was the dead body of the oak that ought naturally to have proceeded from those roots, and the madroña was gradually overgrowing trunk and branches, laying its outside wrapper along like deposits of fat. The trunk was overgrown all but about a foot in some places, less in others (the trunk being perhaps seven or eight feet in circumference), and the branches were gradually, apparently, covered by the madroña covering, the solid part being madroña, and the dead limb of the oak projecting. Again, close by was another pair, oak and madroña,

[1] Conducted by Prof. G. L. Goodale.

growing in the same way, both very large trees; but in this case the madroña trunk was perfect, the branches very flourishing, and only here and there the remnants of the oak branches projecting, which were being rapidly covered, and apparently in a few years there will be no external evidence that there was anything but a madroña, yet it has plainly absorbed a large oak tree. Farther on, investigating other madroñas, I found exactly the same thing, except that the tree absorbed was a bay (*Oreodaphne*)." — Pelham W. Ames.

The Sexual Reproduction of Fungi. — That several classes of fungi exhibit a sexual as well as a non-sexual mode of reproduction has been considered to be established by the researches of De Bary and others. In the section of Ascomycetes this was held to be effected by the union of the pollinodium or antheridium, as male organ, with the ascogonium, resulting in the production of the asci. The most recent investigations of Van Tieghem and Cornu throw the gravest doubts on this supposed sexual process. They assert that the so-called "pollinodia" of De Bary are in reality strings of conidia or vegetative cells which themselves germinate without any process of impregnation. Van Tieghem's observations were chiefly made on the two Ascomycetous genera *Chætonium* and *Sordaria*, but apply also to lichens and to the alleged conjugation of male and female organs which is stated by some writers to take place on the mycelial threads of certain Basidiomycetous genera, as *Coprinus*. The life-history and mode of reproduction of all the Fungi seem to be still involved in the greatest obscurity; and all the new systems of classification based on these characters must be regarded as provisional only. — A. W. Bennett.

Botanical Club at Providence, R. I. — It gives us pleasure to announce that a Botanical Section of the Franklin Society has been recently formed at Providence, and that it has already gone to work with a will. Short reports of the meetings have been published in the Providence papers, and they indicate a purpose on the part of the society to thoroughly explore the remarkable flora of Rhode Island.

Botanical Papers in Recent Periodicals. — *Flora*, No. 28. Dr. Müller, New Brazilian Rubiaceæ. Carl Kraus, Mechanics of the Growth of Seedling Roots. De Krempelhuber, Brazilian Lichens. No. 30. J. Wiesner, A New Self-Registering Auxanometer (an instrument for measuring rate of growth). No. 31. Westermaier, Cell-Division in the Embryo of Capsella Bursa-Pastoris. Drude, On a Mixed Heath-and-Meadow Vegetation.

Botanische Zeitung, No. 41. Eriksson, On the Point of Growth (punctum vegetationis) in the Roots of Dicotyledons. No. 42. Behrendsen, On the Flora of the Northeast part of Zemplin (Hungary).

No other foreign journals have at the present date come to hand.

ZOÖLOGY.

NOTES ON SOME OREGON BIRDS. — *Ampelis garrulus* (Linnæus). This bird was first noticed here as early as November, but at no time was it found in large flocks. The greatest number I saw at any one time did not exceed twenty. They feed on the wild rose berry almost if not exclusively during the winter, filling their crops to their utmost capacity and growing very fat. At times they were very shy, at others just the reverse. I noticed them only along the creeks, where they were feeding or resting. I believe they roost among and on the wild rose bushes, as I have found them there at twilight and early morning. I have not noticed them making any unusual noise, though in large flocks they might make plenty of i , and very likely would. According to Degland, the female has no white or yellow on the inner webs of the secondaries. I find that each has the white or yellow extending around the point and on the inner web of the secondaries.

Pipilo megalonyx (Baird). This bird appeared here in early spring; was quite shy. Its resort is along the creek, rarely leaving it, though at times it is seen on the neighboring foot-hills. I have seen it fly several hundred yards without lighting. It feeds on the ground, scratches a great deal, and is restless. At times they fly rather high. They leave here in April, returning on their way south in September, about the 15th.

Passerella Townsendii var. *schistacea*. This bird also is very shy, seeks the dense thicket and undergrowth, and scratches on the ground among the dead leaves, doubtless feeding on seeds and insects. I believe it breeds here, but am not positive. Goes south in September.

Junco Oregonus Townsend. Winters here; migrates late in the spring, but, I think, only to the high mountains. Its habits are much the same as other snow birds.

Melospiza melodia var. Found here early in the spring. It is a great songster and sings very sweetly. I do not know the variety.

Melanerpes torquatus (Wilson). Breeds here and is numerous. I know very little about them.

Pelecanus trachyrhynchus (Latham). Breeds here, makes its nest on a lonely island, in the sand or loose earth, lines it with a very little grass or roots. Its eggs are white and rough, as a rule two only in a nest, though some are found with three eggs. They nest in large groups, the nests being side by side and covering acres. — GEORGE R. BACON, U. S. A., Camp Harney, Oregon.

HABITS OF THE WHISTLER. — March 7, 1874, Sidney B. Ceby, of Rowley, shot in Castle Neck River, Ipswich, Mass., a female whistler or golden eye (*Bucephala Americana*) whose stomach contained nothing but Indian corn, *Zea mays*, of the variety grown in the Northern States. The kernels were whole, as if recently swallowed.

Castle Neck River is a purely tidal estuary, the water is salt, and the place where this bird was shot was only half a mile from the open sea. At this time of the year no corn could be obtained in the fields, as the farmers all house their corn in this locality, in the fall, and it is a mystery where the bird could have obtained it, as it is the wildest of the ducks that visit this part of the coast.

I have never found in the stomachs of this species anything but fish, shell fish, and marine plants and insects, except in this instance, which I I think is the only one on record. The bird was given to me by Mr. Ceby, and upon dissecting it I found the corn as above stated. If any one can give a like instance among the *sea ducks* I should like to hear of it through the columns of the Naturalist. — J. Francis LeBaron.

ANTHROPOLOGY.

Cordate Ornament. — A stone object, plowed up in Chester County, Pennsylvania, some twenty years ago, has just been brought to my attention. It is "heart-shaped," made of a coarse, micaceous sandstone, and measures two and a quarter inches from the notch to the apex, two and a half inches across the broadest portion of the lobes, and averages three fourths of an inch in thickness, one lobe being somewhat larger than the other. The edges have evidently been worked and rounded by aboriginal tools, and the notch may have been partially cut at the same time, as the upper portions of the lobes would indicate. This has, however, been deepened artificially by the over-zealous discoverer, with a metal instrument, as may be seen in the sharply cut outlines, which possess a much more recent appearance than the other portions, the grains of sand, in many cases, having been severed and smoothed, The object was, possibly, intended for a rude ornament; or it may have been fashioned for purposes of sepulture. The former supposition seems improbable, as the material is so coarse and crumbles easily, while there is no orifice or projection by which it might have been suspended. The point is somewhat truncated, which has probably been effected by pounding, as it has a ragged, rough appearance.

The two-lobed form is but a conventional device of civilized man to represent the human heart, and it is not at all probable that the North American Indian employed such a figure before he came into contact with the Europeans, especially as he does not use it in his paintings and etchings at the present time, but copies directly from nature. To be sure, the symbol was used in the hieroglyphics or picture-writings of ancient man in the eastern hemisphere, but we have no proof that it occurred in the rude rock-etchings of nomadic tribes in the United States. This form of ornament is so scarce that it can hardly represent a type. I have seen but this one and have heard of but two others, one of which is figured by Dr. Rau in his Archæological Collections of the United States National Museum. The latter was said to have been

found in an Ohio mound, lying on the neck of a skeleton. The three, occurring in widely separated localities and made by different races, must be considered as accidental specimens. No one of them, however, can be certainly considered as a purely aboriginal production, all having been either tampered with or manufactured for purposes of fraud. — E. A. Barber.

Anthropological News. — Number 23 of the publications of the Western Reserve and Northern Ohio Historical Society is a tract of eight pages upon Archæological Frauds, written by Colonel Charles Whittlesey. A list is given "of all the engraved stones in the United States," nine in number, which have come under the observation of the author. They are the Grave Creek Stone; a quartz axe, sketched by Dr. G. J. Farish for Professor Wilson; a grooved axe or maul, reproduced by Dr. Wilson, on page 412 in his Prehistoric Man; the Holy Stone, of David Wyrick; an epitome of the ten commandments in Hebrew, found by Mr. Wyrick; a stone similar to the Holy Stone, from a mound in Licking County, Ohio; a grooved stone axe, from Butler County, Ohio; a stone alleged to have been plowed up on the eastern shore of Grand Traverse Bay, Mich.; and a stone maul found, in 1875, in an ancient mine pit, near Lake Desor, Lake Superior. The prinicpal part of the tract is devoted to the various copies and versions of the famous Grave Creek Stone. Six drawings are given, the last being a copy used by Monsieur Levy Bing, at the Congress of Americanists, at Nancy, in good faith, as a Canaanitish inscription. Colonel Whittlesey joins with our ablest archæologists in deprecating the credulity which attaches to these palpable frauds.

The Pennsylvania Historical Society have published Heckewelder's Indian Nations, as the twelfth volume of their series. The apology that Mr. Heckewelder had filled his book with "the national traditions and myths of the Indians" can but provoke a smile from those who have sought for days through wearisome pages to hear the story of the red man's faith from his own lips. This reprint of an old book has our unqualified praise for the spirit which conceived it, and the taste and accuracy which characterize its execution.

The Smithsonian Report for 1875 is just issued and contains the following anthropological matter: International Code of Symbols for Charts of Prehistoric Archæology (illustrated), by O. T. Mason; Certain Characteristics pertaining to Ancient Man in Michigan, by Henry Gillman (illustrated); The Stone Age in New Jersey, by C. C. Abbott, M. D. (223 illustrations).

The war in the Turkish provinces has awakened a fresh interest in the ethnological questions involved in this classic land. Perhaps there is no corner of the world where the questions of race, religion, language, and government more overlap and intermingle. To those of our readers who take an interest in these phases of the controversy we recommend the

two articles in the *Geographical Magazine* for October, by Mr. Ravenstein, accompanied by four maps exhibiting the spread of Mohammedanism, the political divisions, the comparative density of population, and the nationalities; and the History of the Mongols from the Ninth to the Nineteenth Century, by Henry H. Howorth. — O. T. Mason.

GEOLOGY AND PALÆONTOLOGY.

The Geological Survey in Charge of Prof. F. V. Hayden. — The productiveness of the work pursued in America by Professor Hayden, the greatness of the results obtained by this savant and the collaborators whom he has associated with him, the hope and expectation of having science enriched by new discoveries of which those of these last times seem but a prelude, — all these considerations have deeply impressed the French savants, who attentively watch the researches of every kind in geography, physics, botany, zoölogy, and especially geology and palæontology, pursued through the unexplored Territories of the United States west of the Mississippi, and towards the Rocky Mountains. It would be impossible to trace out, even in a summary, what is the most striking and interesting part in the undertaking of Professor Hayden, and I must merely mention some essential points which from the speciality of my studies I am prepared to appreciate to their full value. It is certain, first, that the Yellowstone or Geyser region, recently surveyed and preserved by the wisdom of the Federal government against the danger of devastation, put to the disposition of science the exposition of an assemblage of phenomena of the highest interest. Their examination will serve to explain the mode of formation of the lacustrine deposits of Europe, where the geyserian action is so remarkably visible. Henceforth it will be easy to follow the proceedings formerly employed by nature on the European Continent, and which now are in full action in the central part of the American Union. It is also evident to the geologist who considers the general classification of the formations, as it is fixed from the order of the materials as they exist in Europe, that a great revolution is preparing in geology from the discoveries in regard to the stratigraphy of the Territories recently explored under the direction of Dr. Hayden. The Dakota group and the lignitic formation constitute, in fact, two systems of an enormous power, wherein the fresh-water formations of an uncommon thickness are directly superposed on the marine beds, or in alternation with them. Of these two systems the one is incontestably cretaceous, the other as incontestably tertiary, and both, equally rich in fossils, animal and vegetable, are so intimately bound together that the passage from the one to the other is by a series of degrees without interruption or gap.

Now this is indeed a fact of immense importance in this, that it disproves all that was supposed to have been observed positively in Europe in generalizing local and partial phenomena. In the minds of

the most eminent geologists of this side of the Atlantic the gaps which distinctly separate the cretaceous from the lower tertiary were admitted as corresponding to the end of a great period, and marking its separation from the following one, abruptly beginning a new order of things. Thanks to the American discoveries due to Dr. Hayden's perseverance we have now before us a formation composed of a union of strata of surprising extent, and these strata when they become carefully studied will teach us how the transition between the upper cretaceous and the most ancient tertiary has proceeded.

The radical separation, admitted until now, of the secondary times in regard to those which follow, is therefore uncertain in such a way that if geological researches, instead of beginning in Europe, had been first made in America, the classification would have been modified according to the facts recently obtained by Dr. Hayden; and we can even assert that it would have been founded upon at least different if not opposite bases. The natural consequence of the discovery of these new formations has been a rich harvest of animal and vegetable fossil remains, vertebrate and invertebrate. Here I will only speak about the plants which by their profusion and their variety form a complete herbarium, by which Mr. Lesquereux, as learned as modest, will be able to patiently reconstruct the vegetation of an epoch of which, a few years ago, even the existence was still unknown, at least contested. Nothing, indeed, was more obscure than the flora of the second half of the cretaceous until the Dakota group offered us their share of vegetable fossils. This obscurity was, and is still, a great obstacle to the study of those plants which show us the most ancient Dicotyledons, and take us back to an age when the vegetation of our globe was being completed by the addition and the rapid development of the highest and most numerous class which composes it at our time. Before this epoch, reduced as it was to a small number of relatively inferior types, the vegetation could evidently furnish to large land animals insufficient food. It is only from the appearance of the Dicotyledons just at the epoch when the strata of the Dakota group were deposited, that both kingdoms began their completion by the rapid and successive development of what they have most perfect in land animals and plants, before the arrival of man himself, this last complement of creation.

Not only have the plants of the Dakota group pre-ented to us types of which we could not formerly suppose the antiquity, but in the tertiary system which immediately follows the Dakota group, in the lignitic formation, the researches inaugurated by Dr. Hayden have already exposed to our knowledge the remains of a number of floras of various stations and of great richness. This vegetation, distinct from that of the Dakota group, is far more recent, but it has also its proper interest. Its relation with European contemporaneous floras has to be determined; its most interesting study will demand a great deal of patience and

hard work. It must be completed in time, by a long series of new researches, and nobody is better able to continue them on the same plan than Dr. Hayden, who has directed them until now with such thoughtful zeal and clearness of plan. The magnitude of the results already obtained warrants the hope of future discoveries. — COUNT G. DE SAPORTA, of Aix, France.

THE GEOLOGY OF ITHACA, NEW YORK, AND THE VICINITY. — The Cayuga Lake basin of Western New York extends in a general north and south direction, attaining a length of over forty miles. The land inclosing it on the north is comparatively low, and the lake is broad and shallow. Southward the land increases in elevation, the lake becomes deeper, and the head of the basin is inclosed by a high hilly region. Along the shores of the lake for its entire extent the various rocky strata from the Salina group to the Chemung are admirably exposed. Ithaca occupies the low alluvial plain at the head of the lake, about four hundred feet below the general level of the surrounding country. Many of the streams entering the valley at this point flow through deep gorges rendering the underlying Chemung rock easily accessible. From Fall Creek, which flows into the lake basin just north of the village, southward to the Pennsylvania line there is a continuous stretch of Chemung strata. Excepting for building-stone and flags, the economic value of this group is not great, as it is made up of shales and thin beds of sandstone. The characteristic fossils found at Ithaca are *Spirifera mesacostalis*, *S. mesastrialis*, and *Orthis impressa*. In addition to these there are a number of species of lamellibranchs, gasteropods, cephalopods, — some of which are quite large, — and brachiopods other than those mentioned. The best, and in fact the only, exposure of the Portage group, which underlies the Chemung, is immediately below the Ithaca Fall in the Fall Creek Gorge. This has afforded well-preserved fossils, some of which are quite rare. *Spirifera lævis*, characteristic of the strata, occurs in great numbers, and so well preserved that the spires are frequently visible where the shell has been removed. But the exposures along the lake shore offer a richer field to the collector. By reference to a geological map of New York the various rocks of the Silurian and Devonian ages will be seen to stretch in long bands from east to west, that is, the beds all dip to the south and are imposed one upon the other in their regular order. As the Cayuga Lake basin cuts them transversely, it forms the basis of an excellent section of the western part of the State. The Hamilton formations are here well developed and are exposed along the lake shore for a distance of twenty-five or thirty miles. North of Ithaca the black, thinly laminated Genesee Shale is met, and, forming cliffs along the shore and precipitous walls to the small streams entering the lake, it continues exposed for two or three miles, thinning out and overlapping the Hamilton rocks proper. This shale affords very few fossils, though some well-preserved plant remains have been found. Separat-

ing the Genesee Shale from the Hamilton Shales a thick band of limestone — the Tully Limestone — rises from the water and after an undulating course of several miles passes off at the surface. Directly beneath this is the Moscow Shale, a dark, laminated mud-rock easily disintegrated by water, the Encrinal Limestone, — a very thin bed, — and the Ludlowville Shale. The Tully Limestone forms a rocky table upon which the streams often flow for a considerable distance, the dip of the bed frequently being so slight as to present nearly a level surface. As they approach the lake the water flows over the hard rocky table and cuts its way through the softer deposits. These are easily disintegrated by the combined action of frost and water, and are washed away, forming caverns below the limestone, which after a time breaks off, leaving large masses in the bed of the stream. This is particularly well exemplified in the glens about Ludlowville (eight miles north of Ithaca) and at Shurgur's Glen, near the lake shore. Both of these localities are much frequented by collectors. *Spirifera granulifera*, *S. medialis*, *S. mucronata*, and *Athyris spiriferoides* are found there in great abundance, also *Phacops bufo* and other trilobites, many species of lamellibranchs, and a number of cephalopods. This formation, known to geologists as the Hamilton Group, including the Tully Limestone, the Moscow Shale, the Encrinal Limestone, and the Ludlowville Shale, continues for many miles along the lake shore. From an economic stand-point the Tully Limestone only is important, being valuable for lime and building purposes. The only minerals found are calcite, in small quantities, and iron pyrites.

We turn now to the superficial deposits and water-courses. At Ithaca there are two distinct types of river or creek valleys — the one with rounded and well-worn sides, the other bordered by precipitous walls of rock. To the latter class belong Cascadilla and Fall creeks, which flow into the Ithaca plain from the east. Their valleys are true valleys of erosion, having been formed since the withdrawal of the vast ice-sheet which swept over this portion of North America in quaternary time. With the exception of Six Mile Creek Valley and that of Cayuga Inlet, which open into the lake basin from the southeast and south respectively, all the streams of this immediate vicinity flow through deep cuts or cañons, in which they descend by numerous cascades and water-falls to the lake. As their valleys are mere chasms, they make no appreciable change in the general contour of the land. With valleys of the first type, however, the effect is of an entirely different character. They are distinctly marked. Their longer slope and greater width make a prominent feature in the topography of Ithaca. Noting in addition the depth at which the water flows, and the small number of cascades and water-falls, the conclusion is at once reached that these valleys have been acted upon by some agency not now in operation. We can observe changes going on in Fall and Cascadilla creeks; we can easily understand how their deep, rocky cañons could be formed and are still being formed by

the action of water and frost upon shale, and we can readily see that the conditions which obtained in the formation of these valleys could never explain the deep, well-marked valleys of Six Mile Creek and the Cayuga Inlet, with their sloping banks and knolls and terraces. These deep, well-worn valleys are undoubtedly the result of glacial action. The mass of ice which filled the Cayuga Lake basin, dividing at its southern extremity, one part — the larger — flowed to the south, wearing down the Inlet valley, and the other traversed the Six Mile Creek valley, both of which were occupied by preglacial streams. The scratches on the polished surface of the underlying rocky table, as seen at the quarry in front of the buildings of the Cornell University, on the eastern edge of the basin, indicate that the glacier followed a direction a little east of south, corresponding with that of the lake. Among the drift accumulations are found bowlders of Oriskany Sandstone, and masses of Hamilton shale, formations which occur to the north, together with small granitic bowlders. The valley of Six Mile Creek furnishes some special examples of the drift phenomena. In several places its old channel has been completely choked up with masses of morainic débris about which the present stream has been obliged to cut its way through deep cañons. It was in this valley, at Mott's Corners, a few miles from Ithaca, that the remains of a mastodon were discovered several years since.[1]

In the cañons of this creek and in the gorges of those streams of more recent origin trap dykes are not uncommon. In some cases they thin out before reaching the surface, as in the cañon of Six Mile Creek above Green Tree Falls. There is no apparent displacement of the strata, the dykes being merely cracks filled with igneous rock.

Intimately related to the geology of Ithaca is the problem concerning the origin of Cayuga Lake. At present this has not been satisfactorily solved. Theories have been advanced, but as yet none are sufficiently matured. A consideration of this subject will require a careful and detailed study of the entire lake system of Western New York. While Ithaca does not present that field of study in structural geology to be found in a mountainous or disturbed region, it does offer many attractions to the collector and student of superficial deposits. — Fred. W. Simonds, Cornell University.

GEOGRAPHY AND EXPLORATION.

Explorations of the Polaris Expedition to the North Pole. — The reports of the scientific results of the Polaris expedition have been delayed simply, we are sorry to say, for want of means for publication. Dr. Bessels, the scientist of the expedition, made valuable collections of animal life at Polaris Bay, between latitudes 81° 20′ and 81° 50′ N., and soon after his return placed in the writer's hands the insects and fresh-water crustacea. Now that the English expedition has returned it

[1] See American Naturalist, v. 314.

is deemed expedient to publish a preliminary notice in order to secure priority. The Hymenoptera were represented by *Bombus Kirbyellus* Curtis, which occurred at Polaris Bay, May 31st and July 10th, and a new species, apparently of an ichneumon fly, *Microgaster Hallii*,[1] found in cocoons at Polaris Bay in June and again July 4th.

Of Lepidoptera *Laria Rossii*, a moth closely allied to our *Dasychira*, was obtained in all stages from the egg to the imago. The eggs are spherical, smooth, and white, 0.06 inch long, and laid in a mass of about sixty, and, as in *Orgyia*, upon the cocoon. The larva when half grown is broad and short, the body, including the hairs, measuring 0.60 inch in length and 0.30 in breadth. The body is densely covered with long, fine reddish-brown hairs projecting in all directions and concealing the head and end of the body. There are six large, short, dense, subconical tufts, the two anterior and two posterior ones black, the middle ones yellowish. Head and body black. The full-fed larva is a little longer, the head broad, and large, and black, as is the rest of the body, including all the feet. In this stage the dorsal tufts are all black, with the hindermost one acute, and more prominent than the others; two segments intervene between the fifth and sixth pair. It is 1.60 inch long and 0.60 inch wide.

The cocoon is loose and thin, made of the long hairs of the caterpillar, held together by a thin, fine, silken web. There is an inner layer of hairs held in place by a very slight web. It is gray in color, and is an inch and a half long by one inch in diameter.

The two specimens of the moth are male and female, well-preserved, and agree with Curtis's description, except that the hind wings are unicolorous, with no "broad, blackish margin."

In the same bottle with the caterpillars of *L. Rossii* occurred a *Tachina* puparium of the usual form and 0.36 inch in length.

Besides this species occurred *Anarta Richardsoni* (Curtis) and *Glaucopteryx sabiniaria* (Curtis) with its larva, already described by the writer in the Monograph of Phalænidæ of the United States.

The following *Mallophaga* have been identified by Mr. S. E. Cassino: *Physostomum mystax* Burm., from *Larus eburneus; Docophorus lari* Fabr., from *Larus glaucus; Goniodes colchici* Denny, from *Strepsilus interpres.*

A small, blackish Poduran, *Isotoma Besselsii*,[2] occurred in abundance

[1] *Microgaster Hallii*, n. sp. Medium sized, black, shining a little more than usual. Antennæ brown-black. Fore and middle pair of legs dark brown. Hind legs a little paler, with the basal third of the hind tibiæ and tarsi pale brown. Venation as usual, with the pterostigma narrower than usual instead of being nearly equilaterally triangular, as in some species. Length 0.12. Twelve specimens. Cocoons of the usual cylindrical shape; white. Length 0.17 inch. Two species of this genus have been recorded by Schiödte from Greenland, but not described. Dedicated to the memory of the late Captain Hall in command of the Polaris expedition.

[2] *Isotoma Besselsii*, n. sp. Intermediate in form between *I. tricolor* Pack., and *I. nivalis* Pack. Body long and slender, antennæ but little longer than the head; joints

at Polaris Bay, July 5, 1872. The Arachnida were represented by four species, two of which have been identified by Mr. J. H. Emerton. *Erigone psychrophila* Thorell occurred at Polaris Bay June 3, 1872, and there were two unnamed species from Polaris Bay. At Foulke Fiord *Lycosa glacialis* Thorell was collected. All the spiders have been sent to Dr. Thorell to report upon. Upon the body of a *Bombus Kirbyellus* occurred several specimens of a *Gamasus*.

Of fresh-water crustacea, besides a Copepod, *Daphnia rectispina* Kroyer occurred abundantly at Polaris Bay, August 1, 1872, as well as *Branchinecta groenlandica* Verrill. — A. S. Packard, Jr.

MICROSCOPY.[1]

Illumination in Connection with Polarization. — Mr. W. K. Bridgman, in a paper read before the Queckett Club, urges the importance of polarization as an element of microscopical illumination. His thoughtful and suggestive paper is very interesting, though far from conclusive in its demonstrations, and greatly marred by an apparent confusion in respect to the propagation, diffusion, and sensation of light. The essential point of his theory is that "it is the polarity induced by the impact of the ray, which excites or confers upon the reflected or refracted portion of the ray a condition enabling it to convey the impression of the object to the eye, and the desideratum is to restrict the effect as much as possible to this one action." It is not polarized light, but the act of polarization to which he attributes the effect. The excellence, for microscopical illumination, of light from a white cloud opposite the sun he attributes to its entire freedom from polarization, while the inferiority of light from a direction at right angles to this, or from the blue sky, is attributed to its being strongly polarized, a scattered polarization being said to afford the worst possible kind of illumination for the microscope. The author finds the best angle at which the light can be allowed to fall upon a painted surface to be its polarizing angle of about 56°, and to an approximate coincidence between the angle most conveniently obtained and the polarizing angle he ascribes the easy and general success in obtaining a good illumination of opaque objects by means of the side reflector or the condensing lens; though the result is at least equally well explained, in both cases, on the old theory that this is the angle at which an intense illumination is easily obtained without the view being obscured by a glare of reflected light. In the use of the Lieberkuhn, the author attributes the facility with which delicate details of structure are rendered visible by light from one edge,

rather short and thick. Spring much longer than in *I. nivalis*, but shorter than in *I. tricolor*, not reaching to the insertion of the hind legs, while the fork is as long as the basal joint. It is black, and 0.06 inch in length. It differs from any American or North European species, and is certainly not the *Podura humicola* of Fabricius.

[1] Conducted by Dr. R. H. Ward, Troy, N. Y.

though quite obliterated by a reflection from its whole surface, to the availability of light at the polarizing angle as compared with vertical rays; but in fact the instrument does not furnish a vertical illumination in any case, and when all light is stopped off except from its marginal portion an equally complete polarization is effected without, in common practice as well as in theory, the advantages attained by a unilateral illumination from one edge only of the reflector. In applying the same law to the use of transmitted light for transparent objects, it is advised to place the lamp in such a position that its rays shall fall upon the mirror at an angle of about 54½° in order that the reflected and refracted rays may be as perfectly separated as possible. To obtain the angle accurately in all these cases, it is advised to set the illuminating apparatus by the aid of a sector or a properly divided card. The employment of the silvered side reflector below the object, as a means of transparent or of dark ground illumination, is mentioned as giving a clear soft light and excellent definition at any desired angle of incidence, no claim being made that its use should be limited to any special angle; a judgment in which all who have been accustomed to use this little instrument as a substage accessory will be likely to cordially concur.

Pollen Tubes for the Microscope. — Mr. J. O'Brien's remarks on this subject, quoted from the *Garden* by the *Monthly Microscopical Journal*, represent that he always failed to succeed in obtaining pollen tubes by dissecting the fertilizing stigmas, though spending much time in the effort, and that he had always seen similar failure attend the labors of others. He therefore recommends that the tubes be obtained on a slide by means of the nectar which appears on the stigma at the time of fertilization. The centre of a common microscope slide is touched to the drop of nectar on the stigma, care having been taken to prevent previous pillage by insects, and the spot of nectar thus obtained on the slide is touched by a mature anther so as to leave a few pollen grains on it. In about half an hour a projection like a fleshy root may be seen to grow from the end of each pollen grain; and after an hour or two each tube will be long and snake-like, the grain still attached and representing the head. The rotation of the contents of the tube may now be observed, the fluid passing down one side of the tube and returning on the other side. Temperature and moisture should be carefully controlled, as the growth depends on the fluid condition of the nectar. When sufficiently developed the object may be immediately mounted by pressing down upon it a cover glass, the nectar soon hardening and forming a mounting material in which the pollen is well shown. Specimens prepared in this manner a year ago are still perfectly preserved. The author presumes that any plant which produces the nectar in sufficient quantity may be treated in this way, though he has succeeded best with bulbous plants, Lilium, Hymenocallis (Pancratium), Crinum, etc. It would be an interesting and useful field for in-

vestigation to determine what artificial preparation could be made to take the place of the natural nectar in these experiments, as a means of obtaining and mounting the pollen tubes of flowers.

San Francisco Microscopical Society. — This society, one of the most prosperous in the country, having outgrown its old quarters, has just moved to new rooms in the building known as the Thurlow Block, corner of Kearney and Sutter streets. The rooms, which were first occupied on occasion of the regular meeting of November 2d, are on the fourth floor, approached by means of an elevator, and consist of a handsomely furnished meeting-room supplied with book-cases and cabinet to contain the rapidly increasing collections of objects and books belonging to the society, and an adjoining room fitted up as a laboratory with abundant facilities for microscopical work.

SCIENTIFIC NEWS.

— Professor James Orton left home during the middle of October for South America, with the intention of exploring the Beni River in the interests of geographical science, natural history, and commerce.

— Under the title Entomologischer Kalender für Deutschland, Oesterreich und die Schweiz, Dr. F. Katter, of Putbus, Germany, has published a very useful pamphlet, containing a diary for 1876, a list of German, Austrian, and Swiss entomologists and entomological societies and journals.

— J. Munsell, Albany, announces for 1877 The Indian Miscellany; containing papers on the history, antiquities, arts, inventions, languages, religions, traditions, and superstitions of the American aborigines; with descriptions of their domestic life, manners, customs, traits, governments, wars, treaties, amusements, exploits, etc.; also sketches of travel and exploration in the Indian country, incidents of border warfare, journals of military expeditions, narratives of captivity, anecdotes of pioneer adventure, missionary relations, etc. Collected by W. W. Beach.

— The well-known London house of Macmillan & Co., publishers of *The Practitioner*, have undertaken the publication in England of Micro-Photographs in Histology, the monthly work conducted by Drs. Seiler, Hunt, and Richardson. A large edition is required by the English profession.

— F. A. Curtiss, of Jacksonville, Fla., can supply the ornamental Florida grasses and air plant (Tillandsia), so much prized for parlor decorations, sea-weeds, wood encrusted with barnacles or burrowed by the teredo, coquina rock, river shells, sea-fans, sea-willow, stag's horn and other corals, sea beans, and anything else in the line of Florida curiosities, including stuffed or live alligators, alligators' teeth and eggs, stuffed birds, etc.; also, views of Florida scenery. The first-mentioned will be *exchanged* for Algæ, curiosities, and articles of use to a naturalist.

— Arthur F. Gray, Danversport, Mass., is desirous of obtaining specimens of *Purpura lapillus*, *Littorina litorea*, *L. tenebrosa*, *L. rudis*, *L. palliata*, *Tritia trivittata*, *Ilyanassa obsoleta*, and *Buccinum undatum* from all localities where they exist. He would like fifty specimens or more of the commoner species, if convenient, from each locality, together with notes in regard to the situations where such specimens were gathered. In collecting specimens, select a fair representative of each species, both small and large specimens. His object is to study the variations of mollusks which are either very common or distributed over extended areas, and then produce a paper upon their variations. Due acknowledgment will be made for any aid rendered.

— Lieutenant Cameron has been created a Companion of the Order of the Bath, and has been promoted to the rank of commander in the British Navy. The narrative of his travels, which will form the most interesting and important work on African geography that has appeared for many years, is now approaching completion. It will be published by Messrs. Daldy and Isbester, London.

— Several sets of plants collected by Dr. Palmer in Arizona and Northeastern California, determined by Professor Gray and Mr. S. Watson, are for sale at ten dollars a hundred. Apply to Dr. C. C. Parry, Davenport, Iowa.

— Dr. William LeBaron, late State Entomologist of Illinois, author of four annual reports on the injurious insects of that State, died October 14, 1876, at Elgin, Illinois. He was the son of Dr. Lemuel and Martha LeBaron, and was born in North Andover, Mass., October 18, 1814. He studied medicine with Dr. Joseph Kittredge in North Andover, and practiced there. He married Sarah Jarvis Carr, of Ellsworth, Maine, and in 1844 removed to Geneva, Illinois, where he also practiced medicine.

— The New York Aquarium was opened October 10th, under excellent auspices, a large number of friends of science meeting in the fine building erected for the purpose, and listening to an inaugural address by Hon. R. B. Roosevelt. Our readers will take a personal interest in this important enterprise from the liberal and scientific spirit that thus far has characterized the management. The manager and projector, Mr. W. C. Coup, directs the attention of the public to a feature of the New York Aquarium which he announces is "specially designed to promote and encourage original scientific research, and aid in the study of natural history in all of its most important branches. This consists in the establishment of a free scientific library and reading-room, as an adjunct to the Aquarium, together with a naturalist's workshop, fitted out with all the needed modern appliances, including microscopes, experimental tanks, dissecting tables, etc. This department is under the immediate charge of Mr. W. S. Ward, at whose suggestion it was established, and we propose to admit to the privileges of this scientific quarter any and

all of those who, either as students or teachers, may desire to avail themselves of the advantages of study and research here afforded."

Conducted in this spirit, and with the patronage of an intelligent public, we may hope for most excellent results. It affords the only means in the country for the study of the development of marine animals during the winter months, and affords a rare opportunity to naturalists in the city of New York, whom we personally envy.

PROCEEDINGS OF SOCIETIES.

Iowa Academy of Sciences, Iowa City. — June 23d. Prof. C. E. Bessey presented A Preliminary Catalogue of the Lichens of Iowa. His list of twenty-six species, collected principally in Central Iowa, includes probably about one fifth of the entire lichens of the State. He presented also A Preliminary Catalogue of the Orthoptera of Iowa, including thirty-nine species found in Central and Southeastern Iowa.

Mounds and Mound-Builders was the subject of a carefully prepared paper by Dr. P. J. Farnsworth, of Clinton, tending to show that the mound-builders were identical in race with the historical Indians of North America. The evidence offered was mainly based on resemblances in anatomical structure and modes of burial between the mound-builders and still existing Indian tribes.

Prof. Samuel Calvin, of the state university, described seven New Species of paleozoic Fossils, found mainly in Howard and Floyd counties, Iowa. He also presented a Notice of a Probable new Species of Elephant, from the modified drift near West Union, Iowa. The structure of the teeth differs from that of either *Elephans Americanus* or *E. primigenius*.

Prof. F. M. Witter presented Notes on the Land and Fresh-Water Shells found near Muscatine, of which he has determined fifty-two species.

The Deposits of the Chemung Group in Iowa were described by Professor Calvin as occupying a narrow area along the south side of Lime Creek for a few miles above Rockford, Floyd County, Iowa. It was shown that forty-five of the fossils of the group do not occur in other rocks in Iowa, and this together with the position of the deposits renders it proper to refer the group to a period above the Hamilton or to the Chemung. The further fact that three fourths of all the fossils in the group have been found nowhere else in the world, justifies the application of some distinctive title to the epoch, and the name "Rockford Shales" was proposed.

Professor Calvin also presented A Preliminary Notice of the Occurrence of Marcellus Shales in Iowa. This paper had reference to the discovery of a dark, somewhat bituminous shale beneath the Hamilton

limestone at Independence, Iowa. One of the shells found in this shale belonged to a genus that began its existence, so far as known, in the Marcellus shales, and this fact together with the position of the shale, justified its reference to the Marcellus epoch. The discovery of this shale with its carbonized plants explains the numerous reports that have gained circulation at various times, concerning the discovery of coal in regions occupied by Devonian rocks.

Professor Bessey read a note on The Colors of Iowa Wild Flowers, presenting tables prepared with a view of determining what influence the total amount of light and heat exerts on the predominant colors of the native Flora.

Academy of Natural Sciences, Philadelphia. — August 8th. Mr. Thomas Meehan referred to observations he had made this season on the nocturnal and diurnal expansion of flowers, and said that, contrary to the popular impression, it was not probable that light or its absence alone determined the opening of the blossoms. There were some plants, as for instance *Œnothera biennis* (the evening primrose), *Anagallis arvensis* (the pimpernel), and others, which remained open or otherwise, longer when the weather was humid or clear, and were looked on in consequence as a kind of floral barometers; but from other facts it was clear that it was not the weather merely, but some other incident accompanying the weather, which governed the case.

Though *Œnothera biennis* and other Œnotheras opened at evening, and if the atmosphere was moist would continue open the greater part of the next day, many species opened only in the daytime, and this they did regularly, quite regardless of meteorological conditions. *Œnothera serrata* of Colorado was one of these. It was regular in opening about noon, and the blossoms were all closed long before sundown.

In other allied families we saw similar divergences. In the cactus family Opuntia and Mammillaria opened only about midday, while most of the Cereus opened at night. The night blooming cactus was a familiar example. But the chief interest was in the fact that many had their special hours of day or night for the expansion. The *Portulaca oleracea* (common purslane) opened about eight A. M., and by nine o'clock had performed all its functions, while a closely allied plant, the *Talinum teretifolium*, from the serpentine rocks of Chester County, opened at one P. M. and was closed by three o'clock. The conditions of the weather did not seem to influence them.

There was the same attention to daily periods in the growth of the parts of plants as well as in the expansion of the petals. In composite plants the floral growth was wholly in the morning, and was usually all over by nine or ten o'clock A. M. The elongation and expansion of the corolla was usually completed in an hour after sunrise, but the stamens grew for an hour more, and the pistils continued for still another. There was little if any growth in the floral parts after nine o'clock in a very

large portion of this order of plants. In grasses, Cyperaceæ, and some rushes also, the floral parts were very exact in their time of opening. In the plantains, Plantago, the pistils appeared a day or more in advance of the stamens, and these last appeared at about a regular time in each day. In *Luzula campestris* he had by a series of observations timed it exactly. Before nine the anthers were perfect, but by ten the pollen had been all committed to the winds and only dried matter remained. So far as he could ascertain, meteorological conditions did not influence the time in the least, in this case.

August 15th. An interesting communication from Dr. Charles Pickering on photographs of Tasmanians at the Centennial Exposition was read by the president. Dr. Pickering has been enabled by means of these portraits to refer the originals to the Papuan race or large New Guinea negro.

Mr. Martindale called attention to the genus *Opuntia*, the only genus of Cactaceæ found east of the Mississippi in the Northern States. Dr. Engelmann describes one species under the name *Opuntia Rafinesquii*, which includes two or three of the species described by Rafinesque. Mr. Martindale had collected in the neighborhood of Haddonfield, N. J., what he believes to be *Opuntia vulgaris*, a species which Dr. Engelmann had not before seen from any locality north of the Falls of the Potomac. The characters of the two species were described and contrasted. A specimen from Woodbury, N. J., was decided to be *Opuntia Rafinesquii*, as were also those from the neighborhood of the coast. Mr. Redfield had heretofore doubted the existence of *Opuntia Rafinesquii* in this quarter, and now believes that the form so called was but a variety of *Opuntia vulgaris*.

Dr. Allen called attention to a deformation in a domestic cow similar to that described by him recently as existing in a Brahmin bull. In the case under consideration a supernumerary anterior limb grows from the shoulder, but it ends in one toe only, instead of three, as in the former case. There is, however, a rudimentary toe and a small protuberance farther up the shaft of the metacarpus.

August 29th. A paper entitled Note on the Discovery of Representatives of two Orders of Fossils new to the Cretaceous Formation of North America, by Wm. M. Gabb, was presented for publication.

September 6th. A paper entitled On the Lingual Dentition, Jaw, and Genitalia of Carelia, Onchidella, and other Pulmonata, by Wm. G. Binney, was presented for publication.

Mr. Meehan called attention to a specimen of an exceedingly curious plant, *Welwitschia mirabilis*, on exhibition in the Portuguese African Section of Agricultural Hall, Centennial Exhibition. He also spoke of his observations upon *Mentzelia ornata*. The plant blooms at night. The flowers open for four nights in succession, after which they cease to do so. One flower was covered with gauze and found to produce seed as freely as those not so protected.

Dr. Asa Gray suggested that the capsules might be swollen without containing perfect seeds.

September 20th. Dr. Leidy spoke of the structure and habits of certain fresh-water rhizopods. In the genus *Hyalosphænia* the test or shell is homogeneous and transparent. Several species have been described, one of which had been discovered in the Sphagnum swamps of New Jersey, and from its resemblance to a butterfly, when the pseudopods or arms are extended, it had been named *Hyalosphænia papilio*. Pores were found to exist in the shell, through which the water passes in and out as the body dilates and contracts. Foreign substances adhere to the naked Amœbas on the part of the body opposite to that from whence the pseudopods are protruded. A sluggish *Amœba* had been observed to swallow rhizopods with shells, and, after digesting the soft parts, the calcareous covering was ejected. Others had been observed to select specimens of diatoms having green digestible matter in their interior, from those which were not possessed of such nutritive material.

At the request of Mr. Meehan, Dr. Engelmann, of St. Louis, spoke of the characters and geographical distribution of *Abies Fraseri*. It closely resembled the common balsam, *Abies balsamea*. The tree seems to be confined to the summit of a small number of mountains about six thousand feet in height. The most prominent distinguishing characters are found in the cones, which have protruding and recurved bracts. It has, however, been found that the microscopic structure of the leaves furnishes admirable distinctive characters. The peculiar structure of the leaves of all these trees allies them more closely to the ferns than to the higher plants. In *Abies balsamea* the cells under the epidermis which are devoid of chlorophyl or coloring matter are few in number, while in *Abies Fraseri* they are numerous and regularly distributed on the upper surface of the leaves. All the firs and many of the pines can thus be distinguished by the structure of the leaves alone. There are a great many plants in the mountains of North Carolina which are found only there. The name Black Mountains is due to the dark color of the *Abies Fraseri*, still more to *Abies nigra*.

Mr. Martindale spoke of the introduction of plants from other localities. He had within the past week collected specimens of *Leonurus sibiricus* at the mouth of the Wissahickon. It appeared to be perfectly naturalized in a space four or five feet square. Mr. Redfield suggested that the seeds might have come in the foreign wool used in the mills farther up the river.

Mr. Canby noticed the rapidity with which *Lespedeza striata* had spread over the western part of North Carolina, Eastern Tennessee, and all over the Alleghany range.

Mr. Gesner spoke of the great benefit derived from the growth of *Lespedeza striata* on pasture lands throughout the Southern States. It grew everywhere luxuriantly, and was eagerly eaten by cattle. It is salivating when eaten by horses, but not so when used by mules.

In continuation Dr. LeConte noticed the increase of introduced species of Coleoptera. One species of *Aphodius*, from the Gulf of St. Lawrence, had extended downward to Massachusetts. Another had spread from Maine to Virginia. Other insects introduced into New England had remained localized.

Mr. Gabb noticed the growth of an introduced plant, the Alfilarillo, *Erodium cicutarium*, in California.

September 26th. Mr. Martindale stated that the foreign plant spoken of by him as having been found at the mouth of the Wissahickon Creek had been determined by Dr. Gray to be *Leonurus glaucescens*. It comes from Siberia, and was probably brought among some of the Centennial exhibits, most likely by way of Japan. He did not think it came in wool, as suggested at a previous meeting.

Dr. Engelmann, of St. Louis, continued his remarks upon the conifers. These plants are found much earlier in geological formations than ordinary flowering plants, which is an additional reason for placing them below the latter. Peculiarities of wood and seed, as well as those of the leaves previously described, were dwelt upon, and the conclusion was reached that these plants stand as a connecting link between the endogens and the exogens.

Dr. McQuillen directed attention to a human skull in which, owing to the loss of the bicuspid and molar teeth in the left side of the lower jaw, an upper molar, failing to meet with the antagonizing tooth, protruded from its socket twice its original length. In addition to this, and from the same cause, the left upper jaw had fallen considerably below the level of the right side, and had in consequence lowered the orbit to such an extent as to produce marked disfigurement during life. The condition of this skull was contrasted with that of one in which all the teeth were in good condition, symmetrical in their arrangement, and illustrating in a marked degree the harmony of antagonism.

October 3d. Dr. Leidy spoke of the results of a dredging excursion on the Schuylkill River. The mud at the bottom of the river was found to be thoroughly saturated with coal-oil, and in consequence thereof all the animal and vegetable life, which the dredging party had expected to find in abundance, had been destroyed. It was believed that this absorption of the coal-oil by the river mud exemplified the formation of bituminous shale.

Dr. LeConte remarked that the only difference between the modern and the ancient bituminous bearing deposits was that in the case of the former the oil came from the refuse matter of the manufactories, and in the earlier formations it was absorbed immediately when exuded by the substances producing it. The origin of these oils from vegetable sources was alluded to.

Rev. Mr. McCook spoke of the architecture and habits of a species of ant, *Formica rufa*. The mature hills formed by these ants were

forty inches in height, thirty-six feet in circumference at the base, and eleven feet at the top. They had probably taken seven years to grow to this size. On account of the dryness of the season, little activity was at first observed among the builders, but a shower of rain commencing to fall, they immediately began to work. The mode of formation of the hills and galleries was described and illustrated by drawings and photographs. It was believed that no liquid was used in building the arches, but the pellets of which they were constructed were dovetailed into each other, and rain seemed necessary to cement the work. The greatest regularity in the galleries seemed to be north and south, while the long slope of the hills was towards the west. This did not seem to be at all dependent upon the direction of the wind, but appeared as if the ants actually build with regard to the points of the compass. The doors of the galleries were not closed at night, as described by Huber. Peculiarities of structures made by ants of the same species in Delaware County and at Rockland were described.

Dr. Leidy spoke of the destruction of plants by ants in the neighborhood of their nests, either by the action of formic acid or by eating the roots. He had observed that a species of grass, *Aristida*, was exempt from this destruction. Whether the ants allowed it to remain for the purpose of strengthening their structure, or because they did not find it palatable, he could not decide.

Mr. McCook stated that the ants observed by him extruded formic acid very vigorously, and he had observed yellow tracks on the trees, which might be owing to this cause.

Dr. Koenig remarked that formic acid would produce a natural cement with the calcareous particles of the mounds.

Dr. Chapman stated that the length of the cæcum given off from the rectum of an ostrich recently examined by him was thirty-five inches. It was believed that the comparative length of this part of the intestine seemed to depend upon the nature and amount of the food.

Mr. Meehan spoke of the *Akebia quinata*, an indigenous plant of Japan, where it bears fruit, although it had not been known to do so in this country until recently, when the fruit had been produced by a vine cultivated by Mr. Canby, of Wilmington, Del.

Mr. Meehan also exhibited a specimen of rare fungus of the genus *Phallus*, which he had recently found on his grounds for the first time in seven years. Its peculiar odor attracted meat flies in considerable numbers. The bearing of the facts spoken of upon the question of insect agency in fertilization was dwelt upon.

Dr. Leidy related his observations upon a species of *Phallus*, and mentioned the fact that insects carried the spores from place to place. The power of insects to convey gangrene and other poisons was spoken of in this connection.

The president announced that the Biological and Microscopical Section

of the Academy proposed giving a microscopical exhibition on the 16th inst.

The following papers were presented for publication: Note on *Ptiloris Wilsonii* Ogden, by James A. Ogden, M. D.; On the Extrusion of the Seminal Products in Limpets, with some Remarks on the Phyllogeny of Docoglossa, by Wm. H. Dall.

October 10th. Dr. LeConte spoke of some larvæ of beetles received from Mr. J. A. Lintner, of New York, which were said to be very destructive of carpets in Albany and the neighboring towns. They were determined to belong to the Dermestidæ, and on further investigation were decided to be the *Anthrenus scrophulariæ*, a European species which had not before been found in this country.

Dr. LeConte called attention to an observation he had seen published to the effect that finely powdered corrosive sublimate scattered upon ant hills drove the inhabitants to an insane rage, when they would fall upon each other and become involved in an inextricable mass, from whence none would escape alive.

Academy of Science, St. Louis. — October 2d. Mr. Riley made a communication on the insect pests at the Centennial Exposition.

October 16th. Professor Potter gave the results of his analysis of Peruvian lignite.

Academy of Sciences, New York. — October 16th. Mr. Alexis A. Julien read some Observations on Prehistoric Remains in Western North Carolina. Prof. Thomas Egleston read a paper entitled Vein Accidents in the Lake Superior Region.

Boston Society of Natural History. — October 4th. Mr. Charles S. Minot read a paper on the Relationship of the Vertebrates and Worms, and Prof. A. Hyatt gave a description of an interesting Tubularian Hydroid.

October 18th. Dr. T. Sterry Hunt made a communication on the Geological Succession of the Crystalline Rocks.

Appalachian Mountain Club. — October 11th. Mr. Wm. G. Nowell gave an account of an exploration of Carter Dome, near the Wild Cat River. He gave a detailed description of the route adopted and of the observations made there. The mountain and those about it he proposes to call the Carter Dome Group, and says that two or three days' work upon the top of the principal mountain will enable the club to obtain an uninterrupted view of all the encircling country. Mr. W. H. Pickering read a paper upon distant points visible from the White Mountains, in which he said it was possible to obtain two hundred and eighty views from Mount Washington, one hundred and twenty-one from Moosilauk, forty-three from Passaconway, and twenty-three from Mount Lafayette. An interesting discussion took place as to whether Katahdin is visible from Mount Washington. Professor C. E. Fay also read a paper concerning Black Mountain, alias Sandwich Dome, in which he favored an adherence to the old name as especially fitting and proper.

SCIENTIFIC SERIALS.[1]

The Geographical Magazine. — November. The Arctic Expedition. On Foot through Central Japan, by E. R. Crooke. J. Bonnat's Exploration of the Volta. Sketches of Life in Danish Greenland. The German Expedition to Northern Siberia. The Expedition to the Lena and Olenek, by A. L. Chekanooski.

The Geological Magazine. — October. On the Tertiary Fish-Fauna of Sumatra, by A. Günther. On *Harpactes velox*, a Predaceous Fish from the Lias of Lyme Regis, by Sir P. Grey-Egerton. The Climate Controversy, by S. V. Wood, Jr. Theories of the Formation of Rock-Basins, by H. Miller. Ground-Ice as a Carrier, by H. Landor. — November. On the "Gondwana Series," and the Probable Age of the Plant-Beds of India, by O. Feistmantel. On the Motion of Glaciers, by J. F. Blake. List of Described American Insects from the Carboniferous Formation. Orthoptera, by S. H. Scudder.

Monthly Microscopical Journal. — November. On the Microscopical Structure of Amber, by H. C. Sorby. Diatomaceæ in Slides of Santa Monica Deposit, by F. Kitton. The Present Limits of Vision, by Dr. Royston-Pigott. Comparative Photographs of Blood-Discs, by G. Gulliver. On the Structure and Development of Connective Substances, by T. E. Satterthwaite. — December. On a New Method of Measuring and Recording the Bands in the Spectrum, by T. Palmer. On the Measurement of the Angle of Aperture of Object-Glasses, by F. H. Wenham. Experiments with a Sterile, Putrescible Fluid, exposed alternately to an optically Pure Atmosphere and to one charged with known Organic Germs of extreme Minuteness, by W. H. Dallinger. On a New Refractometer for Measuring the Refractive Index (Mean Rays) of Thin Plates of Glass, Lenses, Wedges, and also of Fluids placed in Cavities or Tubes, by Dr. Royston-Pigott. The Gladiolus Disease, by W. G. Smith.

Errata. — Vol. x., page 634, first and second lines from bottom, page 635, second line from top, for *venation* read *vernation*.

Page 729, thirteenth, fifteenth, and twenty-eighth lines, for *Wales'* read *Wale's*.

Page 729, last line, omit the comma after "Powell."

Table of contents, third page, last line, for *Nichols* read *Michels*.

[1] The articles enumerated under this head will be for the most part selected.